DISSERTATION ON

COMPARATIVE ANALYSIS OF FUNCTIONAL OUTCOME OF DISTAL FEMUR FRACTURES TREATED WITH LOCKING COMPRESSION PLATE FIXATION AND DYNAMIC CONDYLAR SCREW FIXATION

SUBMITTED FOR`

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GOVERNMENT GENERAL HOSPITAL,

THE TAMILNADU DR.M.G.R. MEDICAL UNIVERSITY

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CERTIFICATE

This is to certify that this dissertation titled "**COMPARATIVE ANALYSIS OF FUNCTIONAL OUTCOME OF DISTAL FEMUR FRACTURES TREATED WITH LOCKING COMPRESSION PLATE AND DYNAMIC CONDYLAR SCREW FIXATION**" submitted by **DR.N.VINOTH KUMAR** appearing for Part II, M.S Orthopaedics Degree examination in April 2015 is a bonafide record of work done by him under my direct guidance and supervision in partial fulfilment of regulations of the Tamil Nadu Dr.M.G.R. Medical University. I forward this to the Tamil Nadu Dr.M.G.R. Medical University, Chennai, Tamil Nadu, India.

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DECLARATION

I **Dr.N.VINOTH KUMAR**, solemnly declare that the dissertation titled "**COMPARATIVE ANALYSIS OF FUNCTIONAL OUTCOME OF DISTAL FEMUR FRACTURES TREATED WITH LOCKING COMPRESSION PLATE AND DYNAMIC CONDYLAR SCREW FIXATION**" was done by me at Rajiv Gandhi Government Hospital during period of **July 2013 to Sep 2014** under the guidance of my Guide **PROF.N.DEEN MUHAMMAD ISMAIL, M.S.ORTHO,D.ORTHO.** The dissertation is submitted in partial fulfilment of requirement for the award of M.S. Degree in Orthopaedic surgery to THE TAMIL NADU DR.MGR MEDICAL UNIVERSITY. Chennai.

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Abstract:

Comparative analysis of functional outcome of distal femur fractures treated with Locking Compression Plate fixation and Dynamic Condylar Screw fixation

Introduction:

Fractures affecting the distal femur are very complex injuries that pose a challenge to every orthopedic surgeon. It involves about 7% of all femur fractures. It commonly occurs during high velocity trauma in younger patients and frequently are associated with other skeletal injuries. In contrast to this, elderly patients with osteoporosis might sustain isolated distal femur fractures from trivial trauma. Despite all advanced Technologies and modern diagnostic imaging modalities versatile implants available in market, more difficulties found in internal fixation and maintenance for the fracture.

Material and Methods:

Our study is short term prospective and retrospective study conducted in Institute of orthopedics and traumatology, Madras medical college, Rajiv Gandhi Govt. General Hospital. Chennai. Tamil Nadu. Patients admitted with distal femur fractures are selected on the basis of inclusion and exclusion criteria. We have followed Muller Classification for distal femur fractures, based on which treatment modalities determined. Adult age group with Type A and C Muller included and Type B and skeletal immature patients and Gr III compound excluded in this study. Our study sample size is 25 patients, of which 10 patients treated with dynamic condylar screw and 15 patients with distal femur locking compression plate. They were processed as per protocol, traction of extremity till the patient get fit for surgery. We have used Extensile Lateral approach to fix the fracture with patient supine with sand bag underneath knee. Fractures treated with either LCP and DCS followed in standard protocol and evaluated in serial follow up. Functional outcome analyzed using standard scoring system called Hospital for Special Surgery.

Observation and Results.

In our study Males are more affected with 80% and age group 40-50 years more commonly involved with 28%. Mode of injury Road traffic accidents in 76% patients and 24% in accidental fall.11 patients got associated injuries. Muller sub type C2, C3 accounts

for 40% of patients. Open injuries of type I and II accounts for 20% of all fractures. Distal femur fractures treated with DCS shows 60% excellent and good outcome and 40% shows fair and poor outcome, whereas those treated with LCP shows 66.6% excellent and good results and 33.3% fair and poor results. Overall in our study 64% excellent and good outcome and 36% poor outcome. Muller sub type A fractures both LCP and DCS producing similar results whereas Muller subtype C, LCP shows very good results when compare to DCS. 5 Patients shown complications like superficial wound infection, deep infection.

Discussion:

Dynamic condylar screw is easy construct with fixed angle of 95^{o} blade plate junction, it has own advantages and disadvantages, it can correct sagittal plane deformity and has good inter fragmentary compression ,relatively easy to insert. It shows very good results in Type A Muller subtype fractures. Demerits of very bulky implant, correcting only medio lateral displacement rather than antero posterior displacement. At least 2.5 to 3 cm bone stock above joint line should be mandatory to insert lag screw and it doesn't have any control of distal fragment antero posterior rotation and medial varus collapse of the distal fragment. To address all this complications Locking Compression Plate introduced, It has got advantages of rigid and anatomical reduction and stabilization. Since it has got multiple purchases in distal fragment, shown good stability and rotation control in all plane. Locking screw design made this implant of choice in osteoporotic elderly patients. Type C fractures with intra articular extension, LCP shows good results when compare to DCS. In the aspects of Cost of implant, technical limitations made this implant inferior to DCS.

Conclusion:

Fractures of distal femur are more common in high velocity injuries and occur in middle aged men and old age women. Most fractures were comminuted. Locking compression plate [LCP] appears to be technically an ideal implant for comminuted distal femoral fractures with proper physiotherapy produced excellent results, whereas extra articular Type A fractures LCP and DCS shown similar results. However large study group and long follow up needed for accurate functional outcome

CONTENTS

INTRODUCTION

Fractures affecting the distal femur are very complex injuries that pose a challenge to every orthopaedic surgeon. It involves about 7% of all femur fractures. It commonly occurs during high velocity trauma in younger group of patients and frequently are associated with other skeletal injuries and concomitant other system injuries. In contrast to this, elderly patients with severe osteopenia might sustain isolated distal femur fractures from trivial trauma such as a simple slip and fall. Treating the elderly individuals with relatively weak bone quality is night mare to surgeons. Though well advanced Technologies and modern diagnostic imaging modalities versatile implants available in market, makes this fractures more amenable to treat satisfactorily. Despite all these modalities ,treatment of distal femur fractures are not without of complications, since most of this fractures located very proximity to traversing neurovascular structures ,hence they are more prone for injury to popliteal vessels and badly comminuted fragments and bone loss, displacement of fragments all these components make this fractures difficult to fixation. Since fractures involving juxta articular location in relation to knee joint, the movement of this joint affected very early and recovery of the lost knee movement is delayed unless followed good physiotherapy and gradual mobilization exercises

Significant advances have been made in treatment of these fractures in the past three decades. Neer in 1967 concluded that these fractures were not suitable for internal fixation and treated with traction & cast bracing. It is recognized that operative fixation with the ability to maintain anatomical reduction of the joint surface, restoring axial alignment and early range of motion presents clear advantages over closed means of treatment. Numerous devices have been proposed for the treatment of these fractures. The principles of internal fixation must be met regardless of the choice of fixation. These include anatomical reduction of the distal femoral articular surface, stable internal fixation, minimal soft tissue stripping and early active mobilization.

AIM AND OBJECTIVES

The aim of this study is comparing the functional outcome of the Patients who sustained the Distal femoral fractures treated with Locking Compression Plate fixation against Dynamic Condylar Screw fixation.

Study Place: Rajiv Gandhi Govt. General Hospital,
Madras Medical College, Chennai

Study Design: Both Prospective and Retrospective Study

Study Period: July 2013 to Sep 2014

Study Sample Size: 25

Ethical Committee: Approved

REVIEW OF LITERATURE

In 1770, LAPEJODE AND SIORE first used brass wire to internally fix long bone fractures.

1933 - MAHORNER and his Colleague BRADBURN reported unsatisfactory results with Russel traction.

1937 - TEES suggested skin traction for reduction and immobilization.

1945 - FUNSTEN AND LEE observed fractures of the distal third healed earlier than that of middle or proximal third.

1948 - UNMANSKY used the reverse Blount plate for fixing the distal femoral fracture.

1951 - DELMORE, WEST and SCHRIBER suggested fibrosis or arthro fibrosis after trauma as the prime cause of knee stiffness.

1953 - LAING P.G studied the blood supply and concluded no major vessels entering distal femur and the abundant blood supply was through genicular vessels and soft tissue attachments.

1955 - WATSON - JONES recommended non operative treatment.

1963 - SIR JOHN CHARNLEY recommended non operative treatment.

1965 - MULLER suggested L shaped compression plate (ASIF condylar plate) and suggested postero lateral incision.

1966, MARCUS J. STEWART, SISK and WALLACE retrospectively reviewed 213 cases of supracondylar and inter condylar femur fractures and recommended, two pin traction as the treatment of choice.

1967 - NEER – classified the supracondylar fractures of femur and advised conservative management[1], [2].

1971 - BROWN & DARCY modified blade plate for use in osteoporotic supracondylar fractures.

1972-OLERUD in his study shows 93% good results in fractures treated with condylar buttress plates, but the procedure was technically demanding with high rate of implant failure which resulted in re fracture after implant removal. The failure rate was high especially in osteoporotic bone.

1973 - CONNOLY advocated closed reduction and cast brace ambulation.

1974 - SCHATZKER reported superior results using operative methods[3].

1974 - NEER – classified supracondylar / inter condylar fractures, used straight plate and screws and considered conservative treatment was superior to internal fixation.

1979 - SCHATZKER J - concluded that results of blade plate fixation were better.

1980 - FRANK SEINSHEIMER - classified distal femoral fractures and advocated fixation for intra articular fractures.

1984 - SWIONTKOWSI et al. described retrograde intramedullary nailing though insertion in the medial femoral condyle which is in line with the center of the femoral shaft in the coronal plane.

1984 - AO/ASIF Universal tibial and femoral nails were used with entry point in the medial femoral condyle.

In 1986 REGAZONNI, RUEDI and ALLGOWER used the Dynamic condylar screw implant system for fractures of the supracondylar fracture femur, but the main disadvantage of condylar screw implant was that the fixation of condylar lag screw results in removal of a large amount of bone which made redo surgery more difficult and varus collapse of the distal fragment was a recognized complication.

1990 - MULLER classified fracture of distal femur (AO classification)

1991 - MARK S BULTER et al. used interlocking intramedullary nailing for ipsilateral fractures of the femoral shaft and distal part of femur.

1991 - GREEN S, SELIGSON D, HENRY SL, TRAGER S primarily used GSH Supracondylar nail (retrograde interlocking nailing)

1991-SANDERS. R., SWIONTKOWSKI, used double plating for comminuted, unstable fractures of distal femur.

In 2000, LCP was approved as new AO plate standard

In 2001 KREGOR P.J. STANNARD J., ZLOWODZKI. M. reported early results with L.I.S.S for distal femoral features.

In 2003 FRIGG. R. published an article about the “Development of the locking compression plate”.

In 2003 SOMMER C, GAUTIERE, MULLER M, HELFET DL,WAGNER reported first clinical results of the locking compression plate.

In 2005 SEAN E. WORK, DANIEL N., studied association between supracondylar- Intercondylar distal femur fractures and coronal plane fractures.

In 2006 HEATHER A., VALLIER reported failure of LCP condylar plate fixation in the distal part of the femur in selected cases.

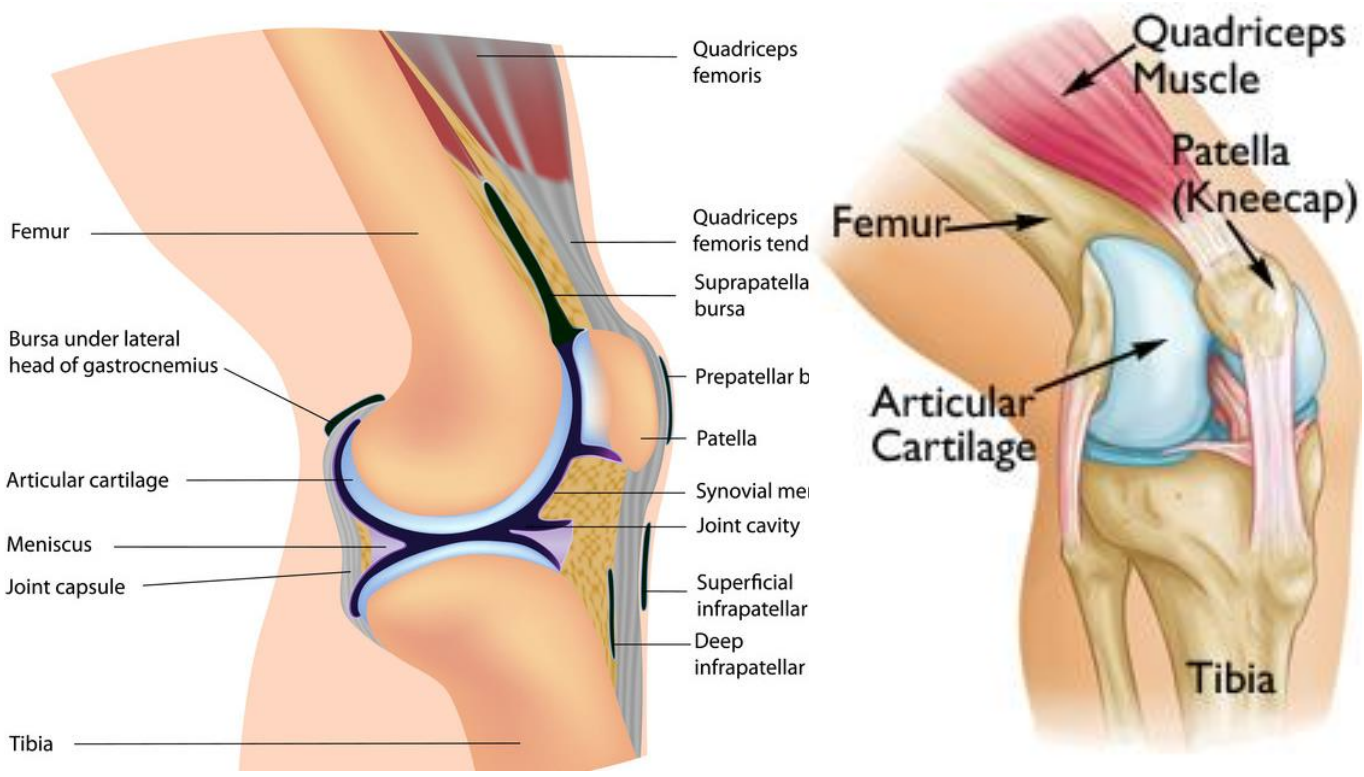
SURGICAL ANATOMY

Distal femur is defined as the zone it comprises both femoral condyles and supracondylar region, junction of the metaphysis with shaft. Distal femur comprises about distal 15 cm of the femur measured from the joint line[33]. Femur flares into two curved condyles at the junction of distal femoral diaphysis and metaphysis. The anterior surface between the two condyles has a shallow depression for articulation with the patella. The posterior surface between the two condyles is separated by a deep inter condylar fossa.

Medial condyle is longer and extends farther distally than the lateral femoral condyle. Outer surface of medial condyle is convex, and an epicondyle on the surface gives attachment to the medial collateral ligament. Adductor tubercle is present on the proximal medial surface of the medial condyle to which the adductor magnus is inserted. The medial head of gastrocnemius arises from the back of medial condyle. Lateral condyle is stouter and stronger than the medial condyle. In the coronal plane lateral condyle is more anterior compared to the medial condyle. This prevents the lateral displacement of the patella.

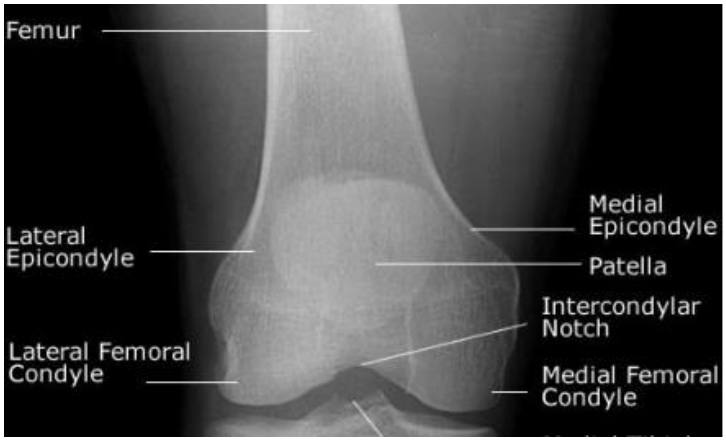
Most prominent part of its lateral surface is the lateral epicondyle to which fibular collateral ligament is attached.

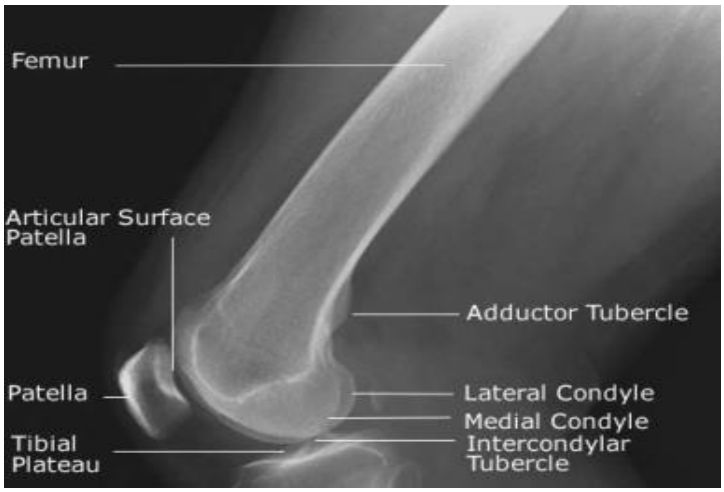
On Axial view distal femur is trapezoidal with greatest dimension located posteriorly and narrowest dimension anteriorly. Lateral wall inclines 10 degrees and medial wall inclines 25 degrees. On average, the anatomical axis (angle between the shaft of femur and the knee joint) has a valgus 12 angulation of 9 degrees.

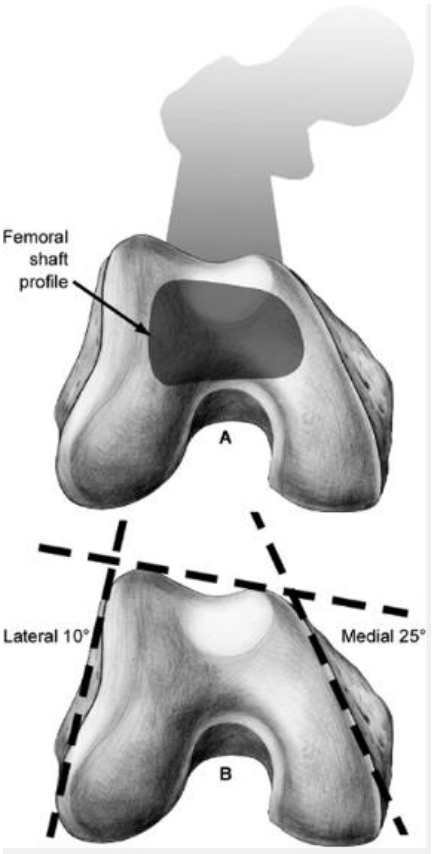


In the sagittal plane , the shaft of the femur lies with anterior two thirds of condyle. Tibial articular surface is convex antero posteriorly as well as from medio lateraly.

Lateral & medial meniscus creates greater conformity between the femur & Tibia. Between the condylar surface, the plateau is elevated into the intercondylar eminence. Capsule of knee joint is attached posterior to proximal margins of femoral condyles and the inter condylar region. Medially the capsule is attached proximal to the groove for popliteus tendon. Anteriorly the capsular attachment is deficient above the level of the patella. The tibial collateral ligament is a flat triangular band superiorly inserted above to the medial femoral condyle and below to the upper part of medial surface of the tibia



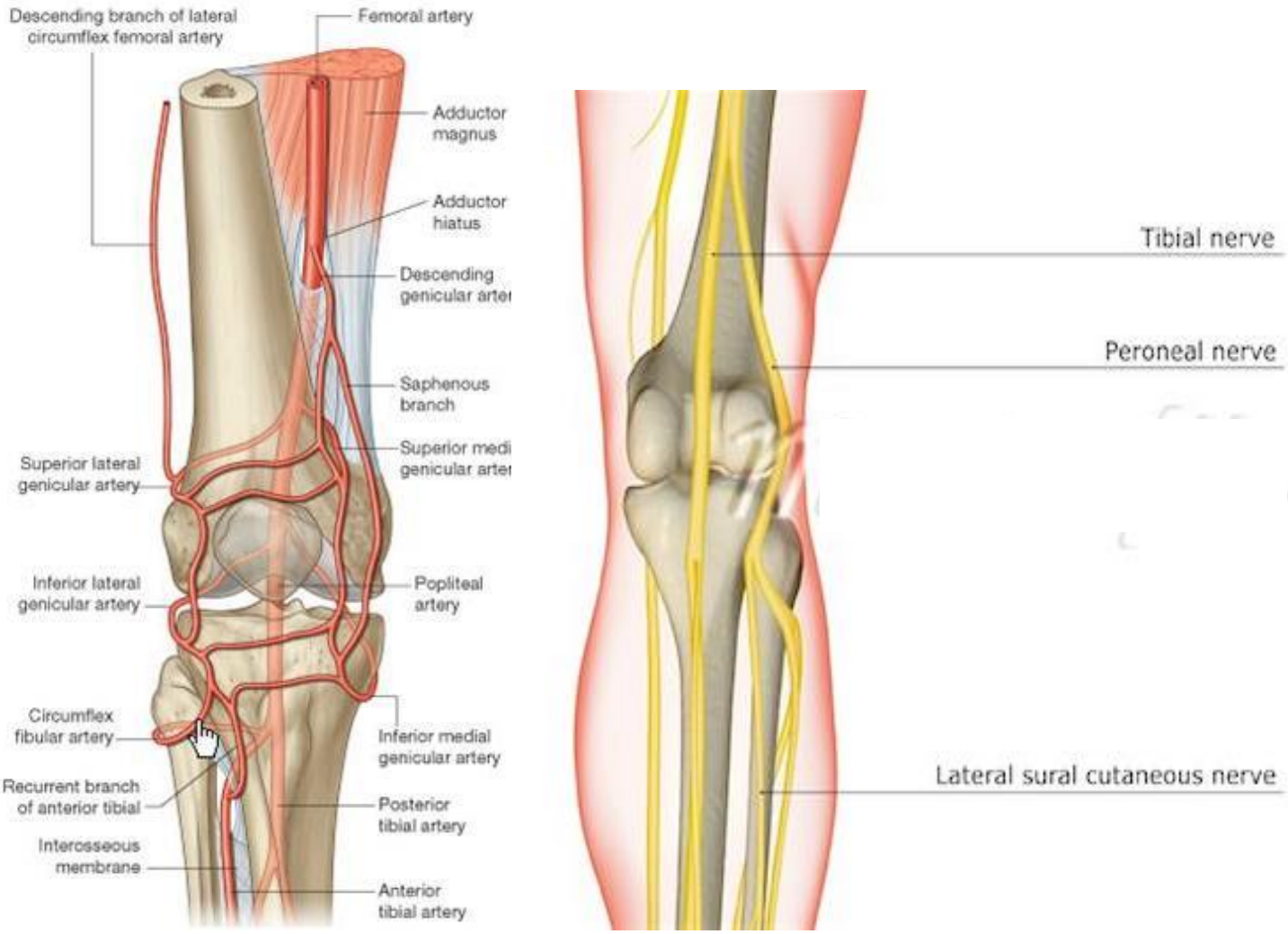




The fibular collateral ligament is cord like and is attached proximally to lateral epicondyle below the attachment of lateral head of gastrocnemius and above that of popliteus tendon. Its distal attachment is to head of the fibula. The cruciate ligaments are a pair of very strong ligaments connecting tibia to femur. They are intra capsular and extra synovial. Anterior cruciate ligament is attached to anterior part of tibial plateau between the attachments of anterior horns of medial and lateral menisci. It ascends postero laterally and is attached to posteromedial aspect of lateral femoral condyle. Posterior cruciate ligament is stronger, shorter and is attached to smooth impression on posterior part of tibial inter condylar area. It ascends antero medially and is attached to anterolateral aspect of medial femoral condyle.

Medial menisci is almost a semicircle and is broader posteriorly. Its anterior horn is attached to inter condylar area in front of the anterior cruciate ligament,while the posterior horn is similarly attached in front of the posterior cruciate ligament. The lateral meniscus is about four fifths of a circle. Anterior horn is attached to front of inter condylar eminence of the tibia, while the posterior horn is attached in front of the posterior horn of the medial meniscus. The intra articular entry point of the retrograde supra condylar nailing is situated about 5mm anterior to the attachment of posterior cruciate ligament in the inter condylar notch.

BLOOD SUPPLY



Distal Femur and knee joint has a rich blood supply supplied from the anastomoses around the knee. The chief contributors are the five genicular collaterals of the popliteal artery. In the anterior approach to the knee, subcutaneous dissection should not be done superficial to the facial layer because which results in devitalisation of the skin can occur.

NUTRIENT ARTERY TO FEMUR

This is originate from the second perforating tributary of the distal end of femur. Nutrient foramen is located on the medial aspect of linea aspera and is directed superiorly. The lower end has rich blood supply through genicular vessels. The lower end ossifies from a single secondary ossification center appearing at the 9th month of – intrauterine life and it gets fused with the shaft by the 20years. The lower end of femur is the growing end.

The lower end of femur is having a lot of applied anatomical importance.

1) Medico legally ossification of lower end of femur is very important. Presence of its center in a newly born child found dead indicates the child was viable and capable of independent existence of birth.

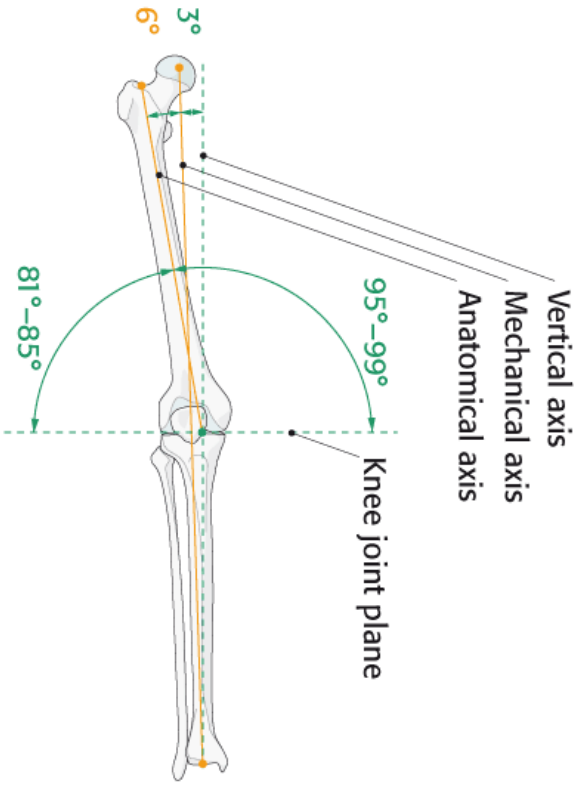
2) The epiphyseal line is at the level of adductor tubercle. Hence intervention here may damage the distal epiphyseal cartilage in children and may entail subsequent shortening of limb.

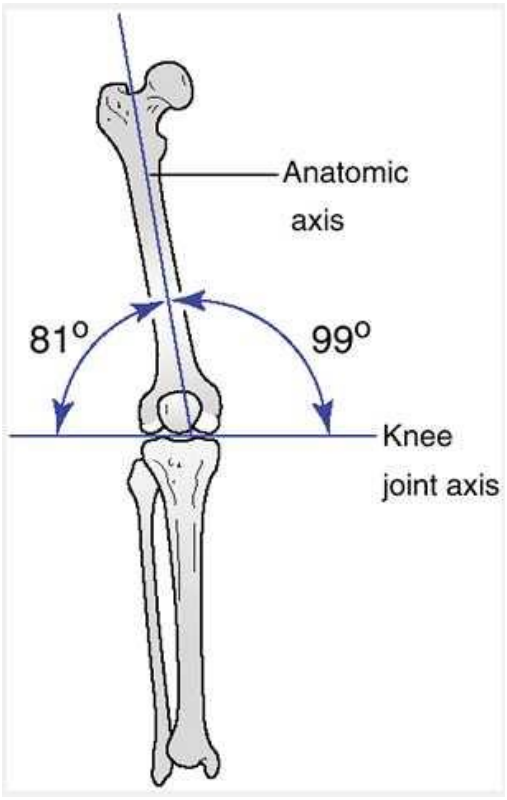
NERVE SUPPLY

The joint is supplied from the femoral nerve from lumbo sacral plexus though its branches to the three vasti, from the sciatic nerve by genicular branches of the deep tibial and common peroneal components and from the obturator nerve by the branch from its posterior division.

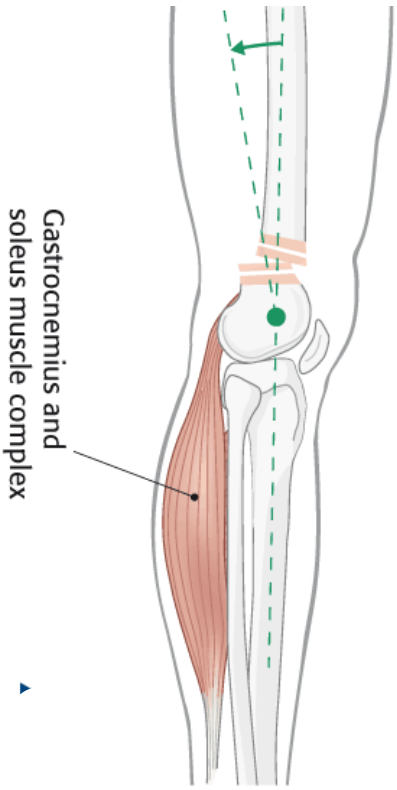
BIO MECHANICS OF INJURY[4]

Most distal femur fractures are the result of a both severe varus, valgus or rotational force with axial loading. In younger age group this amount of force is typically the result of high velocity trauma such as motor vehicle accidents and falls on a bend knee may be sufficient to produce these fractures. After fracture, the deformities observed are usually results of femoral shortening with posterior angulations, and posterior deviation of the distal fragment. These deforming forces are produced by the quadriceps femoris, posterior muscle group hamstrings, and gastrocnemius muscles.





Varus deformity may result from the pull of the adductor muscles. If an inter condylar fracture is present, there will often be rotational misalignment of the condyles (with resulting joint incongruity) because of the separate attachments of the gastrocnemius muscles to each condyle.



The axial bending loads applied to the femur in the production of a supracondylar fracture may produce additional injuries to the same extremity. Physical examination and radiographic assessment must assess the possible presence of a fracture to the acetabulum , femoral neck and shaft

Varus or valgus force applied to the knee may result in associated ligament injury to the knee. Alternatively the same force may produce fractures of tibial plateau or shaft. Open fractures occur in 5- 10 % of all supracondylar fractures. Most common site for the open wound is over the anterior thigh , proximal to the patella and as a result patients have some damage to the distal quadriceps muscle or tendon.

Although femoral and popliteal arteries are at risk of injury because of their close proximity to the site of fracture, the incidence of associated injury to these vessels is low. The popliteal artery is more commonly at risk of injury when an associated posterior dislocation of knee occurs.

CLASSIFICATION

A Classification for distal femur fractures should distinguish possible injuries to this area, including extra articular, intra articular and isolated condylar lesions.

1. Allow different surgeons consistently & reliably to grade a fracture pattern into one of the classification patterns.

2. Assist in deciding the method of treatment.

3. Correlate with findings of outcome analysis.

Many classification systems have been used for fractures of distal femur like Neer et al., Schwatzker and Tile, Seinsheimer and Muller et al. The most widely accepted and used is that of Muller et al.

NEER CLASSSIFICATION

Neer classified these injuries into:

1. Minimal displacement

2. Displacement of condyles Medial Lateral

3. Concomitant supracondylar and shaft fractures.

It is an anatomical classification and does not correlate with the severity of the Injury

SEINSHIEMER CLASSIFICATION

He classified these injuries into:

i. Non displaced fracture

Any fracture with less than 2 mm of displacement of fractured fragments.

ii. Fractures involving only the distal metaphysis without extension into the lnter condylar region.

a. Two Part fracture.

b. Comminuted fractures.

iii. Fractures involving the inter condylar notch in which one or both condyles are separate fragments.

A. Medial condyle is a separate fragment, lateral condyle remains attached to the femoral shaft.

B. The lateral condyle is a separate fragment, medial condyle is intact.

C. Both condyles are separated from the femoral shaft and from each other.

iv. Fractures extending through the articular surface of the femoral condyles

A. A fracture through the medial condyle (two parts are comminuted)

B. A fracture through the lateral condyle (two parts are comminuted)

This classification is exhaustive and is no longer used

AO /ASIF CLASSIFICATION- MULLER CLASSIFICATION,

The classification described by Müller et al. and expanded in the AO/OTA classification is useful in determining treatment and prognosis. It is based on the location and pattern of the fracture and considers all fractures within the trans epicondylar width of the knee.

AO Classification based on Muller et al. is as follows:

A Extra articular fracture

A1 Extra articular fracture, simple

A2 Extra articular fracture metaphyseal wedge

A3 Extra articular fracture metaphyseal complex

B Partial articular fracture

B1 Partial articular fracture, lateral condyle, sagittal

B2 Partial articular fracture, medial condyle sagittal

B3 Partial articular fracture, frontal

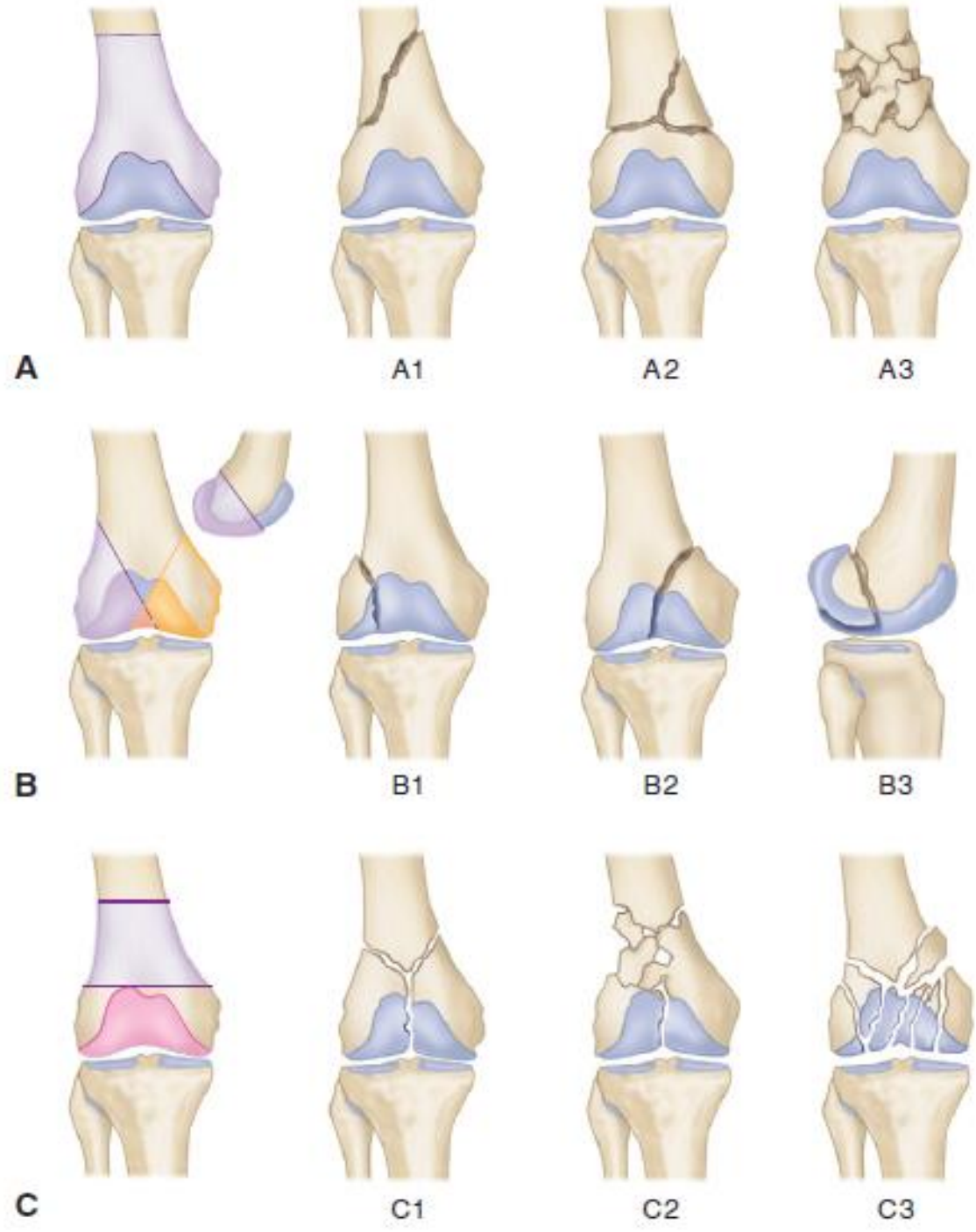
C Complete articular fracture

C1 Complete articular fracture, articular simple, metaphyseal simple

C2 Complete articular fracture, articular simple, metaphyseal multi fragmentary

C3 Complete articular fracture multi fragmentary.

This classification is widely accepted and although the classification is complex, severity of the fracture progressively increases from one type to the next. **Hence we have followed this classification in our study.**



DESCRIPTIVE CLASSIFICATION:

- Open injury or Closed injury
- Location of fracture whether supra condylar, inter condylar involvement
- Pattern of the injury spiral, oblique, or transverse
- Intra articular involvement or not
- Angulation of fracture - Varus, valgus or rotational deformity
- Displacement of the fracture- Shortening or translation
- Comminution, Segmental and butterfly fragment

INVESTIGATIONS

Clinically the patients may present with symptoms and signs either of supracondylar fractures (or) other major problems like hypovolemic shock. All patients with fracture lower end of femur should be looked for peripheral pluses.

A good quality X ray in two perpendicular views is a must to look for the subtype of Muller's classification. Computer tomography portrays the distal femur in cross section, which helps to identify fracture lines in the frontal plane. Two and three dimensional reconstructions may also improve understanding of the fracture pattern in preparation for surgery.

PRINCIPLES OF MANAGEMENT

There are a lot of factors which play a important role in management. They include.

1. Pattern of fracture displacement
2. Degree of comminution and bone loss
3. Extent of soft tissue involvement
4. Associated Neurovascular complications
5. Severity of joint involvement
6. Degree of Osteopenia
7. Associated injuries
8. Complex ipsilateral injuries (patella/ tibial plateau fracture)

So the objective of treatment of fracture of lower end of femur are

1. To obtain and maintain accurate reduction and stable fixation of the fracture.
2. To restore a functional range of motion of knee joint
3. To restore normal strength of quadriceps and hamstring muscles group.
4. To treat the associated injuries.

Distal femur fractures with multi system involvement like pelvic organ injuries blunt injury abdomen, head injury must be managed as multi-disciplinary approach.

METHODS OF TREATMENT

In the decade of 1960s, conservative methods such as traction of involved limb and cast bracing, produced better results than operative management, because of the lack of adequate internal fixation of the fractures. With the development of improved internal fixation devices, treatment options begin to change in 1980s. The blade plate designed by the AO group was one of the first used device and gain wide acceptance for management of fractures of the distal femur. As it was technically complicated , a less technically demanding device Dynamic Condylar screw was introduced. Those fracture for which both Dynamic Condylar screw & Condylar Blade Plate could not be used remained a problem which was sorted out by the introduction of Condylar Buttress plate. The intramedullary nailing were used in the treatment of distal femoral fractures, because they obtained more biological fixation. Nails have been designed specifically for retrograde insertion through inter condylar notch for the treatment of supracondylar and inter condylar femoral fractures. Flexible intramedullary implants like Zickel's supracondylar device, Ender rods, Rush rods have been used with success to treat distal femoral fractures.

External fixation was used as either temporary (or) definitive fixation in severe open distal femur fractures especially those associated with vascular injury.

A recent advance in technology for the treatment of distal femoral fractures includes the less invasive skeletal stabilization system (LISS) and the locking compression Condylar plates (LCP). They offer multiple points of fixed angle contact between the plate and screws in distal femur (Angle stable construct), reducing the tendency for varus collapse and at the same time afford better stability. Hence management of distal femur fracture can be divided into two broad categories.

1. Conservative treatment
2. Operative treatment

CONSERVATIVE MANAGEMENT

Considerable controversy existed as to whether conservative (or) surgical treatment leads to better results for management of distal femur fracture. Early attempts at internal fixation of these complex injuries were associated with high incidence of malunion, nonunion and infection.

Because of the increased risk of complications, numerous authors concluded that closed methods were preferable to operative treatment. With the improvement in surgical techniques, availability of better implants, prevalence of better antibiotics, the conservative management has become almost not applicable for fracture of lower end of femur. In this modern era of fracture management, there is no single absolute indication for conservative treatment.

The relative indications for conservative therapy include.

1. Non displaced (or) Incomplete fractures.

2. Impacted stable fracture in elderly osteoporotic patients.

3. Lack of modern internal fixation devices.

4. Unfamiliarity or inexperience with surgical techniques.

5. Significant underlying medical disease.

6. Advanced osteoporosis

7. Spinal cord injury with fractures.

The goals of conservative treatment are not anatomical reduction of fracture fragment but restoration of overall length and axial alignment.

The criteria's for acceptable fracture management include

1. $< 7^{o}$ mal alignment in frontal plane.

2. $< 10^{0}$ mal alignment in sagittal plane

3. Limb shortening < 1.5 cm.

4. Articular incongruity < 2 mm

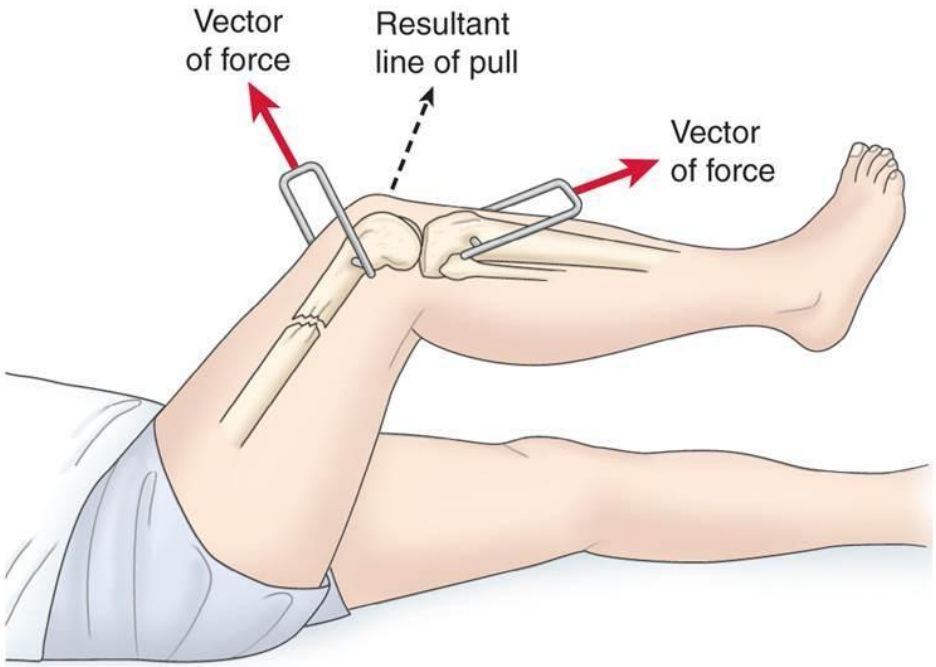
Various methods of conservative management include

1. Two pin method of skeletal traction – One through upper tibial and other through lower femoral pin.

2. Skeletal traction with single pin followed by cast immobilization.

3. Ambulatory cast brace method.

4. Fracture Brace technique.



TRACTION

Traction can be used for management of Muller type A and B supracondylar femoral fractures as long as it is possible to restore limb longitudinal alignment, axial rotation, and limb length. Commonly, it involves skeletal traction with one pin placed 10 cm below the tibial tuberosity and the leg maintained in a Thomas splint with Pearson attachment at the level of the fracture and flexed about 20° or on Bohler Braun Splint. And applies 10 to 15 kg of traction, in line with the thigh segment. The patient must remain bed bound with maintenance of traction for 2 to 12 weeks, depending on the fracture.

SURGICAL MANAGEMENT [10,11,12,13,14]

INTRODUCTION:

In the past 25 years, internal fixation of displaced fractures of lower end of femur has gained widespread acceptance as operative technique and implants have improved. The combination of properly designed implant, a better understanding of fracture pattern, meticulous soft tissue handling, judicious use of antibiotics, and improved anaesthetic methods have made internal fixation safe and practical. Since 1970, all studies comparing the results of conservative and operative methods have favored operative stabilization of distal femur fractures.

The goals of operative treatment of distal femur fractures are

a) Anatomical Realignment of fractures

b) Stable fixation of the fractures

c) Early Mobilization of the knee joint

d) Early functional rehabilitation of joint by physiotherapy

Indications for operative management include

1) Displaced intra articular fragments

2) Poly trauma patients with multi system injuries

3) Open fractures

4) Associated vascular injuries requiring repair.

5) Severe same limb injuries (patellar fracture, tibial plateau fractures)

6) Major associated knee ligamentous injuries.

7) Irreducible fracture.

8) Pathological fracture

9) Fractures around TKR (Peri prosthetic)

Contraindications to internal fixation include

1) Active infection elsewhere

2) Severely contaminated open fracture (type III B)

3) Massive comminution (or) bone loss

4) Severe osteopenia

5) Inadequate facilities

6) Inexperienced surgeons

Principles of internal fixation.

Sequences in the surgical management of supracondylar fracture includes

1) Restoration of articular surface

2) Metaphyseal alignment.

3) Impaction of fracture in osteoporotic patients.

4) Early mobilization of knee.

In Operative Treatment, Various Modalities Include

1. Open Reduction Internal Fixation with Dynamic Condylar screw

2. Open Reduction Internal Fixation with Condylar blade plate

3. Open Reduction Internal Fixation with Condylar Buttress plate

4. Open Reduction Internal Fixation with Cancellous screws

5. Closed reduction & internal fixation with ante grade locking nails.

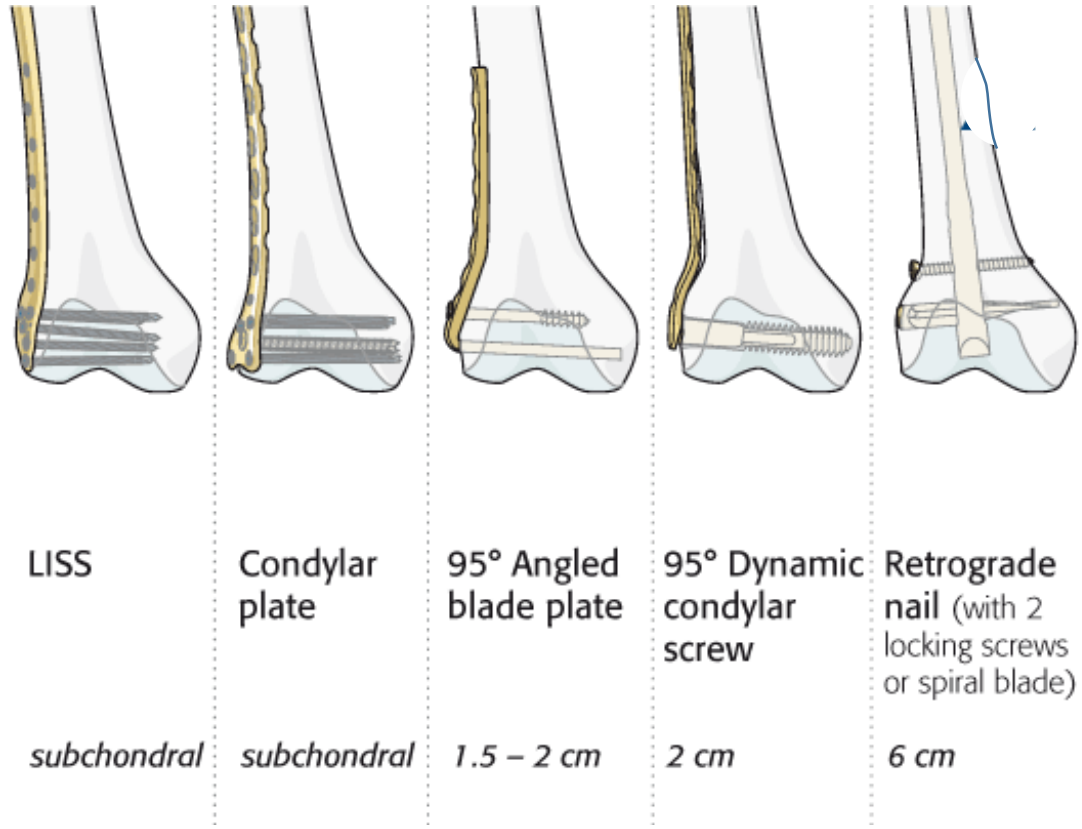
6. Closed Reduction & Internal Fixation with supracondylar nail.

7. Closed Reduction & Internal Fixation with flexible intramedullary nail.

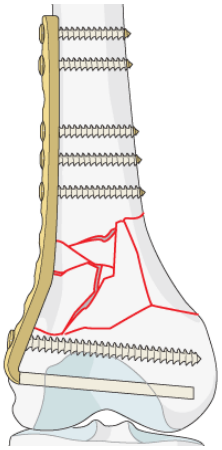
8. Ilizarov ring fixation

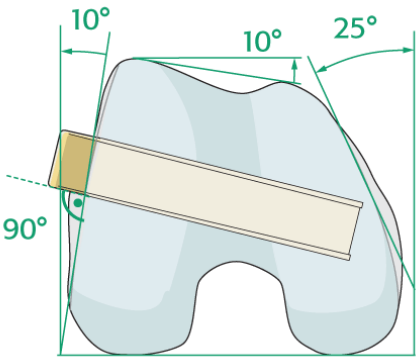
9. External fixation.

10.Open Reduction internal fixation with locking compression plate. (LCP)



95^0 CONDYLAR BLADE PLATE (CBP)[4,36,46]





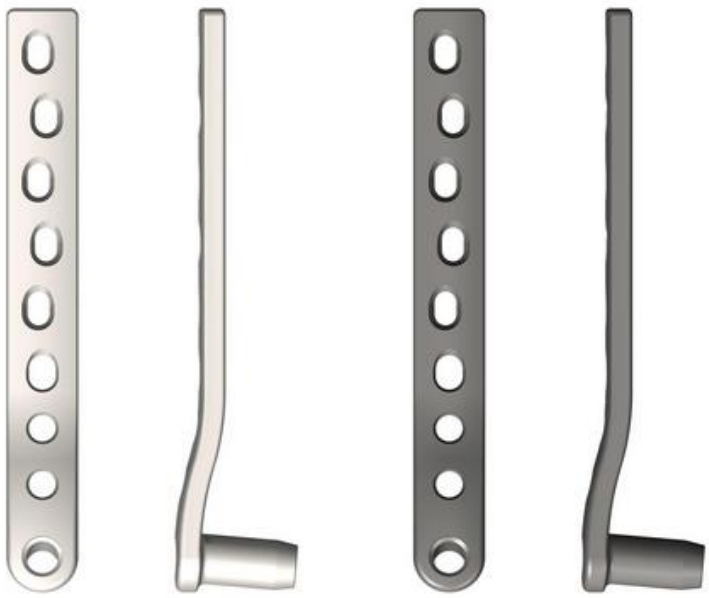
It is the first implant used for supracondylar fractures. When used by experienced surgeon, this restores alignment and provides stable internal fixation. Because it is a one piece device, it affords the best control of the fracture. However placing of 95ºCBP is technically demanding procedure, leaving little room for error. It can be used for inter condylar fracture, provided the lateral cortex is not comminuted.

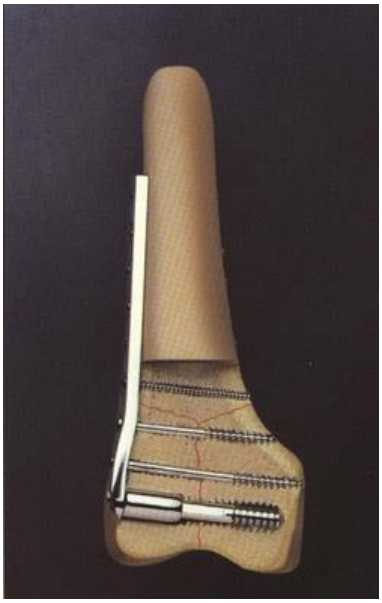
The main advantages of CBP is increased strength and increased corrosion resistance of implant. The disadvantage is the increased difficulty of insertion. In the distal femur, the blade has to be inserted so that it will line up with the axis of the shaft and with joint axis and with the inclination of patella femoral joint and be inserted exactly in the middle of anterior half of the femoral condyle at a predetermined distance from the joint and has to line up with the axis of femoral shaft. Initially the 130° plate was used for the distal femur also. With time it became evident that the 95° plate was the physiological one.

So CBP has a fixed angle of 95° between its blade and plate. Plate comes in varying diameter. The length to be used varies with fracture pattern. The shortest available blade is 50 mm.

DYNAMIC CONDYLAR SCREWS (DCS)[35,48]:

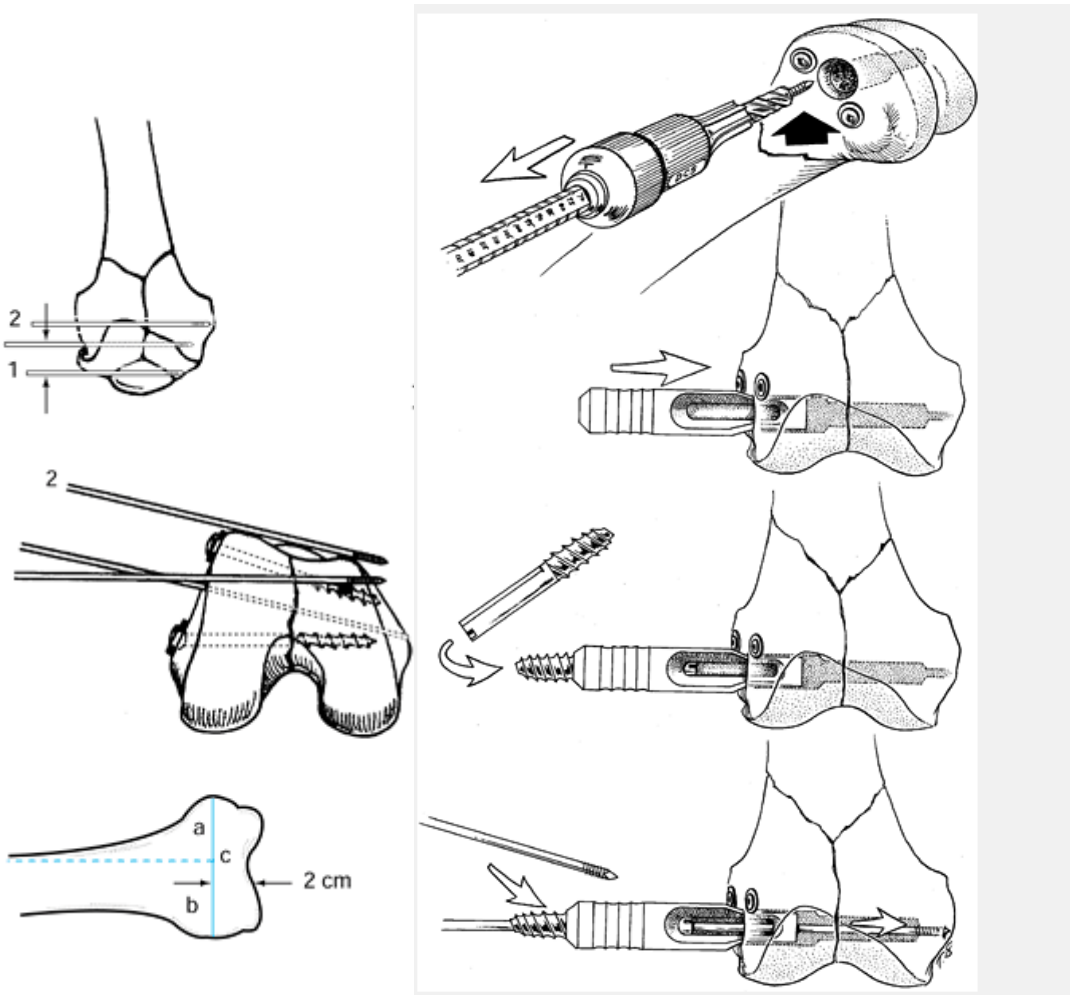
The DCS has 2 major components interconnected with a small compressing screw. It has a 95 degree angle between the screw and side plate, and both the screw and side plate are available in a variable lengths. The condylar screw must be introduced parallel joint line on the both AP and Lateral view of femoral condyles so that the plate will sit flat on the lateral mid femur. Proper alignment in the technique, mainly based upon use of K-wires and the available aiming devices, is mastered.





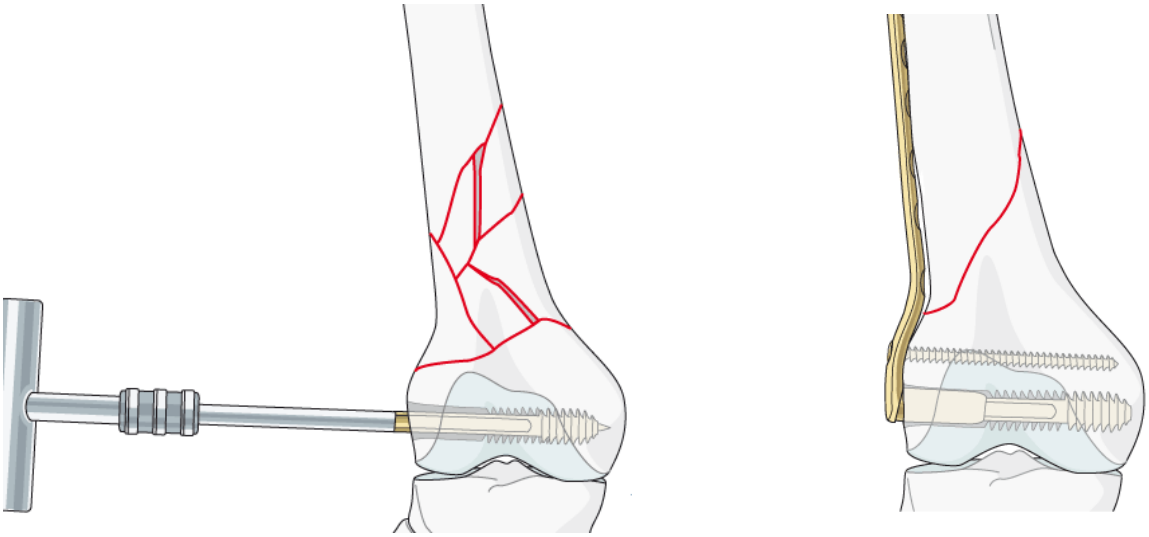
We can determine the position of the condylar screw by placing three K-wire. The location of the site for insertion of the screw, and for a blade plate as well, must be precise if the side plate is to lie on the mid portion of the lateral

aspect of the femoral shaft. To determine this, measure 2 cm proximal to the articular surface and draw a line with a marking pen at right angles to the axis of the femoral shaft .The DCS angle guide is a mirror image of the side plate and is used in placing the guide wire through the lateral condyle. The guide pin must be parallel with the first and second guide wires.



It is the definitive guide for the triple reamer and the subsequent placement of the large condylar lag screw. Insert it under C arm control until the medial

cortex is reached. the direct measuring device over the guide wire and read the length of the guide pin to be inserted into the femur . Reverse calibration on the measuring device allows direct measurement of the guide pins taking the measurement, advance the guide wire a few more millimeters to further engage the medial cortex to help prevent inadvertent removal of the guide wire with the triple reamer. Over penetration will result in prominence of the lag screw in the knee joint, which is painful. Assemble the triple reamer, which allows you to set the depth in 5 mm increments and has a locking nut to prevent slippage of the depth setting during the reaming procedure. Set the depth setting to about 10 mm less than the measurement taken from the measuring device. The reamed channel will end around 10 mm from the medial cortex.



Slip the cannulated triple reamer over the guide wire. If the patient has good cancellous bone, tap the reamed channel for the lag screw threads. Use the DCS tap with a short centering sleeve to tap to the same depth as the reamed channel. No need of tapping in case of patients with osteoportic

bone[21].Assemble the DCS and place it onto the wrench using the long centering sleeve. Position the assembly over the guide pin and insert the centering sleeve into the reamed hole .Insert the screw until the zero mark on the wrench reaches the lateral cortex. The tip of the lag screw is about 10 mm from the medial cortex, and the proximal end of the lag screw is even with the lateral cortex. In osteoporotic bone, insert the lag screw to the 5 mm mark, which allows the tip of the lag screw to cut itself 5 mm beyond the reamed channel. With the lag screw properly inserted, the T handle of the insertion wrench should be parallel with the shaft of the femur.

Remove the wrench with its centering sleeve and slide the appropriate-length side plate over the lag screw. Withdraw the guide pin. Use the impactor to seat the side plate gently. Insert the dynamic condylar compression screw .When fixing a T or Y fracture with split condyles, inter fragmentary compression can be achieved with the compressing screw. Do not compress with the compression screw in osteoporotic bone because the lag screw may pull out of the bone.Supplemental fixation of the side plate to end fragment by inserting one or two 6.5 mm cancellous screws through the plate immediately proximal to the large condylar lag screw. Ensure that the proximal component of the fracture is realigned.

Use a tension device to achieve trans axial compression. After tension is applied to plate, clarify the reduction and stability of the lag screw fixation. If both are satisfactory, complete screw fixation of the plate to the shaft.

. One technical disadvantage of this device is that its shoulder is more prominent than that of an angled blade; it causes knee symptoms such as the ilio tibial sliding over the prominent edge of the implant producing severe irritation. In low supracondylar fractures, the condylar screw may not provide as much rotational control of the distal fragment as the 95° CBP.

CONDYLAR BUTTRESS PLATE[4]:

Blade plates and condylar screws are unsuitable for use in fractures with <3-4cm of intact femoral condylar bone and in fracture with a large amount of articular comminution. For these fractures, the Condylar Buttress plate is the most commonly used implant. It is a one piece device specifically designed for the lateral surface of distal femur. It is essentially a broad DCP with a cloverleaf shaped distal portion designed to accommodate up to 6 cancellous screws. Because the posterior portion of

cloverleaf is larger than anterior portion. It is manufactured separately for right and left sides. Mechanically it is not as strong as a blade plate or condylar screw with side plate and therefore should not be used or substituted for these preferred implant,. The problem with condylar buttress plate is that the screws

passing through the distal holes do not have a fixed relationship to the plate., With indirect reduction techniques (such as the use of distraction device) the screws may shift relative to the plate producing varus deformity or valgus deformity., So its use should be restricted to cases in which the lateral femoral condyle is comminuted or there are multiple intra articular fractures in coronal plane or sagittal plane. In cases with extensive medial comminution a second medial plate need to be used to prevent varus deformity.

ANTEGRADE INTRAMEDULLARY NAILS:

Intramedullary nailing has received increased attention for the treatment of distal femoral fractures. These devices obtain more biological fixation than plates because they are load sharing rather than load bearing implants. They offer greater soft tissue preservation. Perhaps the most common application for an ante grade nail is a fracture in distal third of shaft of femur with fracture extension into the supracondylar region of knee joint, where it can also be used along with a small plate. The major disadvantage of nail fixation is that, it provides less rigid stabilization of distal femur fractures than plate fixation in biomechanical testing. Distal locking of the ante grade through supra condylar region with locking compression screw will give only protection in single plane medio laterally but antero posterior angulation could not be controlled. Expert nail with antero posterior screw an poller screw will give rotation control

SUPRA CONDYLAR NAILS:

Nails have been designed specifically for retrograde insertion through inter condylar notch. It was developed by Green, Seligson and Henry and hence called GSH nail. It is a cannulated closed section stainless steel intramedullary device designed specifically to provide fixation for supracondylar fracture.

It has an 8° apex anterior bend near the distal end to accommodate, the geometry of femoral condyles and transverse holes along its entire length to allow interlocking with 5 mm diameter interlocking screws. It is available in various lengths and diameter the most unique feature of the GSH nail is its intra articular starting point, which allows it to be used for very distal fractures. Closed placement with indirect reduction of the fracture minimizes soft tissue and periosteal damage, thus preserving vascularity of the fracture site. Less surgical dissection is required resulting in less blood loss, less muscle damage

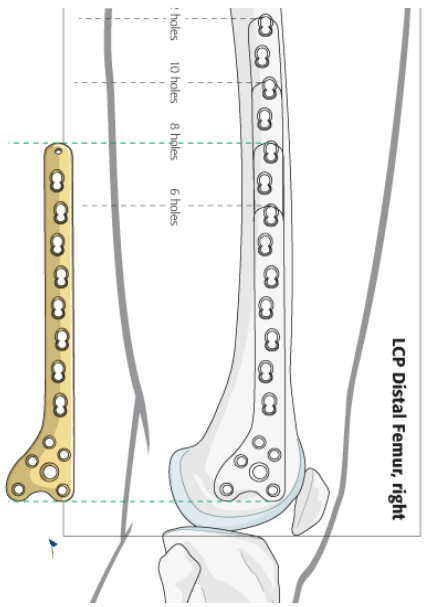
and less postoperative discomfort. Distal femoral fracture below hip implant or above total knee implants with an open notch design may be effectively treated with retrograde nails. It can also be used in cases of floating knee, for simultaneously fixing femoral or tibial fractures. The design of the retrograde supracondylar nail is associated with potential disadvantages as well. The intra articular portion will lead to knee stiffness, knee sepsis, patella femoral degeneration, and synovial metallosis. The proximal tip of the nail generally lies in the mid or distal femoral shaft, creating a stress riser in this area.

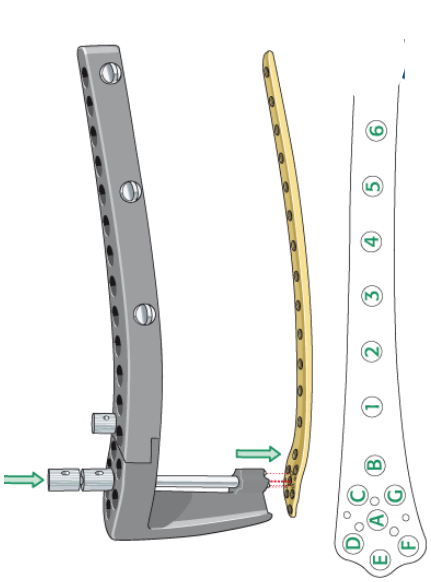
FLEXIBLE AND SEMIRIGID NAILS:

In 1970 Zickel developed a nail specifically for use in distal femur; the nail has a flexible stem and a rigid curved condylar part, allowing it to be anchored by trans fixation screws into femoral condyles.

Closed Rush pinning was also used for treatment of supracondylar fracture. But it was associated with complications like pin migration, knee irritation, loss of reduction & mal union.

LOCKING COMPRESSION PLATE[5,15.16,21,23]





The plate system has many similarities to traditional plate fixation methods with few improvements such as Locking screws provides fixed angle construct and improved fixation in osteoporotic bones [26,27,28]

1. The screws do not rely on plate bone compression

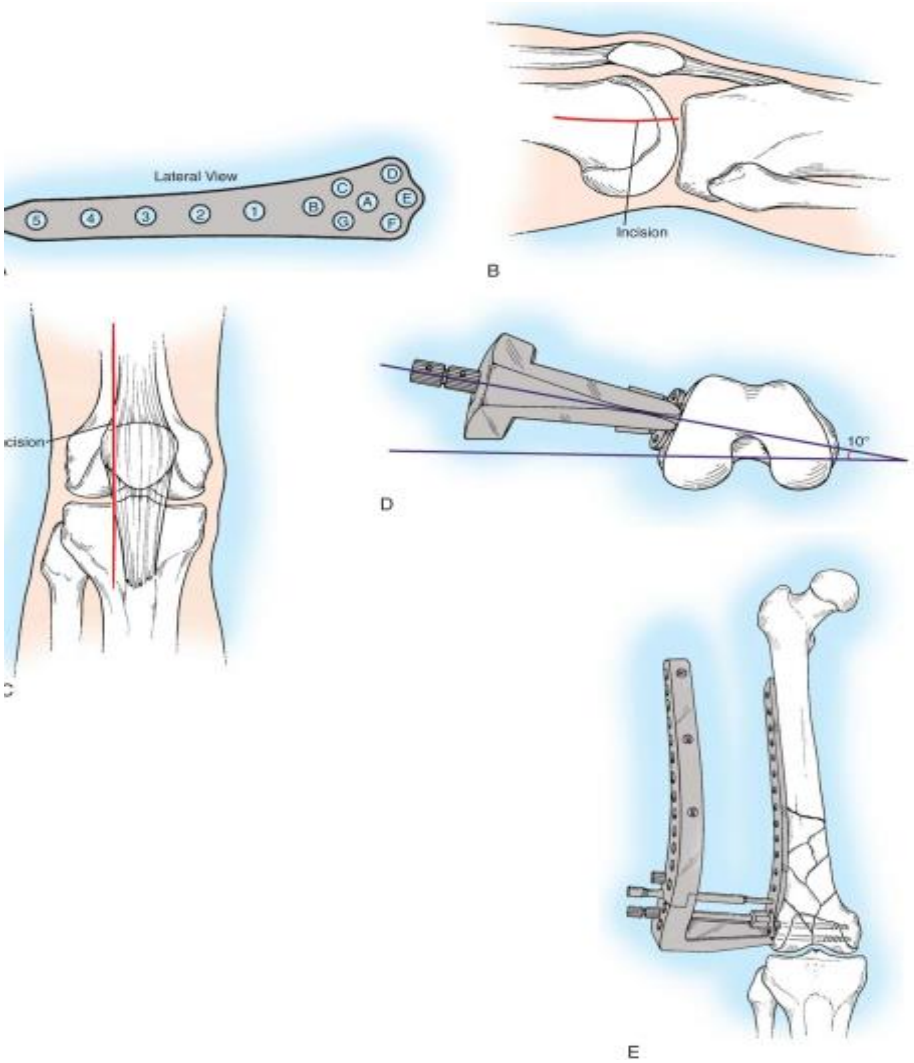
2. Multiple screw fixation in distal femoral condyle allows improved fixation in Type C3 fractures

3. Anatomically shaped distal end is contoured to match the distal femur and hence intra-operative contouring is not required.

4. Combi - holes have additional dynamic compression holes providing options for axial compression in addition to locking mechanism

5. Lateralisation of proximal femur is prevented by maintaining a gap between the proximal fragment and the plate until locking screw is applied after which the alignment is maintained

It combines the advantages of the dynamic compression plate principle with the locking screw head principle, giving the surgeons great flexibility of choice within a single implant. The screw holes in plate have been specially designed to accept either a standard cortical screw with a hemi spherical head or a locking screw with a threaded head.

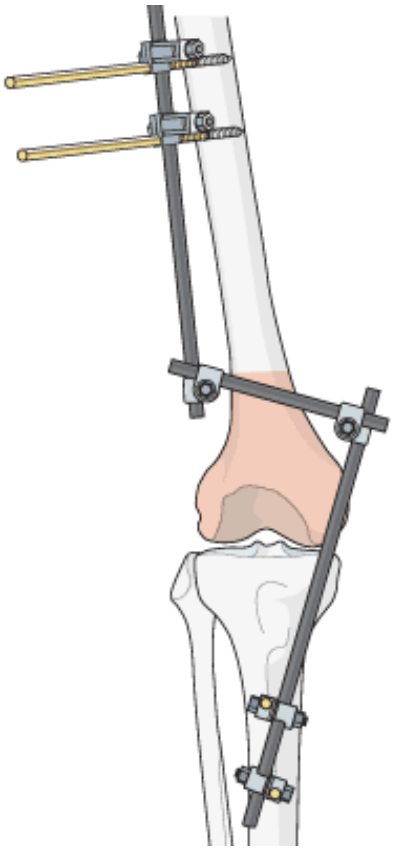


A locked screw plate construct can be compared to an implanted external fixation device[6]. When under load, the screws in the LCP plates distribute loading on cortical and cancellous bone. They form an angle stable construct. The plate is manufactured with a beveled edge, right and left separately because of larger posterior portion. The plate is pre contoured to the lateral surface of distal femur. It allows up to 3 screws in the condylar potion. It comes in various lengths 5, 7 & 9holed.Anatomically pre contoured: Reduces soft tissue problems and eliminates the need for plate contouring.

LCP combi-holes: Intraoperative choice between angular stability and compression. Guiding Jig: Enable easy and correct mounting of the plate and enable screw fixation through guide and centering sleeves. There is no consensus on the best treatment of complex intra articular fractures and high energy diaphyseal fractures of the long bones. The new screw-plate systems seem to offer an excellent alternative for the operative fixation in these cases

EXTERNAL FIXATION[15]

External fixation can be used as either temporary or definitive fixation in severe open distal femoral fractures, especially fractures associated with vascular injury. External fixator can be used as temporary stabilization of fracture or definitive treatment for few kind of fractures.



\It plays major role in treating distal femur or tibial plateau fractures associated with neuro vascular injury, it assist as skeletal stabilization for both vascular surgeon as aid in exploring the vascular structures and enhance wound healing for plastic surgeons. In type III fractures spanning of the knee joint is mandatory to avoid further cartilage injury .Knee joint stiffness and infection

of pin site limits this mode of treatment only to Gr III compound fractures. For mobilization of poly traumatized external fixator play pivot role. External fixator removal and definite procedure should be carried out within 14 days to avoid pin tract infections. Major complications include pulmonary embolism, infected nonunion, and aseptic nonunion. The early conversion from a spanning external fixator to an intramedullary nail was safe in patients with multiple injuries. External fixators have incidence of infection of about 1 % to 10 % and also knee stiffness unavoidable due to span the knee joint. Early reversal to definite procedure will improve clinical out come

POSTOPERATIVE MANAGEMENT:

Postoperative management depends upon the individual patient needs. If patient has type C and other system involvement like chest injury, head injury or pelvic injury, it is better to have management in multi centric intensive setup. Antibiotics given according to the severity and nature of injury .In stable internal fixation the patients were started on knee mobilization & CPM exercise from 24-48 hours after surgery once the patient tolerates pain, Isometric muscle strengthening exercises & limited active assisted knee range of motion is encouraged. Patients initially encouraged to tip toe down walking it will increase callus formation over 6 weeks, complete weight bearing advised only after 12 weeks

COMPLICATIONS[7,8,9]

The surgical treatment for supracondylar femoral fractures now has a better outcome than in the past because of improved implants. However the new methods are not without problems.

Complication of fractures:

1. Infection

2. Vascular injuries

3. Nerve injuries

4. Nonunion

5. Mal union

6. Pulmonary complications

7. Missed ligamentous injuries

8. Knee stiffness

Complication of operative treatment:

1. Incomplete reduction

2. Incongruous reduction

3. Loss of knee motion

4. Infection

5.Implant Breakage[16,19]

INFECTION:

The major drawback of fixation of supracondylar femoral fracture is the high risk of infection. However it should not exceed 5%. If wound drainage develops postoperatively, aggressive irrigation and wound debridement indicated. Appropriate antibiotics should be given intravenously for 3 to 6 weeks. In florid infections it is better to keep implant in situ rather than removing it is because stable infected injuries better manage than unstable fractures. However if the implant is loose, it should be removed and the fracture should be protected with external fixation.

NONUNION[29,30]:

It is much more common in conservatively treated cases than in surgically treated cases, owing in part to the rich blood supply to the distal femur and the predominance of cancellous bone. Nonunion generally is due to presence of infection, unstable fixation, mechanical failure of the implant or any combination of these factors. Treatment may be difficult owing to preexisting osteopenia, proximity to knee joint and prior surgical procedures. Aseptic nonunion should be treated by repeat osteo synthesis. Septic nonunion should be treated with external stabilization

POST TRAUMATIC ARTHRITIS:

The incidence of post traumatic arthritis is unknown. However incongruity of the joint surface is the leading cause of the early arthritis. Unfortunately lot of patients developing post traumatic arthritis is young patient becoming unsuitable for TKR. Arthritis affecting only part of the condyle then plan for corrective osteotomy, if involve both compartment and patello femoral compartment it is better proceed with arthrodesis or total knee replacement. Patients age and available range of movement and presence of Fixed flexion contractures and sepsis will play major role in surgical management of this kind of fractures.

KNEE STIFFNESS:

The most common complication that occurs after Distal femur fracture is loss of knee movement. This is unavoidable complication either due to damage to quadriceps mechanism and intra articular injuries by trauma or surgical fixation, Quadriceps scarring following injury or arthro fibrosis of knee joint is the reasons for knee joint stiffness. Moreover it is aggravated by immobilization of the fracture either by external and internal fixation. Immobilization more than 21days usually leads to few degrees of knee joint stiffness. Early mobilization of patient, active and passive quadriceps physiotherapy exercises and meticulous soft tissue management will increase the chance of good outcome in distal femur injuries.

Patients with significant loss of motion after an injury may be candidates for quadriceps plasty as a late reconstructive procedure.

VASCULAR INJURIES :

The exact incidence of vascular injury accompanying supracondylar fracture is unknown but is estimated to be only 2-3 %.Vascular injuries can be caused by direct laceration (or) contusion of the artery or vein by fracture fragments or indirectly by stretching leading to initial damage, clinical examination for signs of ischemia with evaluation of pulses and motor and sensory function is essential.

MALUNION [29]:

Mal union of both medial and lateral condyles very common due to improper fixation against mechanical forces against the joint and soft tissue imbalance around the joint. Mal united fractures leads to not only mechanical limitation and limping ,often sets in early secondary arthritis of joints if it involves intra articular injuries.

PULMONARY COMPLICATIONS

When stabilization of the fractures was delayed in patients who had multiple injuries, the incidence of pulmonary complications was higher, patients who

were treated conservatively or with late stabilization of fractures in poly trauma had high incidence of fat embolism (22%).

ASSOCIATED LIGAMENTOUS INJURIES

Concomitant ligamentous injuries to the knee are uncommon and are rarely diagnosed preoperatively. The most commonly injured Ligament is Anterior Cruciate ligament. Initially non operative treatment is advocated as repair (or) reconstruction may produce further comminution, prolonged operation time and increases the risk of loss of knee motion and infection. Protected motion in conjunction with a knee orthosis and vigorous rehabilitation may obviate the need for late reconstructive surgery. If necessary late reconstruction should be done after the fracture has healed.

MATERIALS AND METHODS

This study pattern in prospective & retrospective study with study sample of 25 patients with supracondylar and distal femur fractures treated with either Locking Compression Plate fixation and Dynamic Condylar Screw at Rajiv Gandhi Govt. Gen Hospital , Chennai from July 2013 to September 2014.Patients were selected from among the admissions to the Orthopaedic ward in the Department of Orthopaedics, Government General Hospital, Chennai and recruited into the study prospectively based on the following criteria.

INCLUSION CRITERIA

All patients above 18 years with closed fractures of supracondylar & distal femur fractures extending up to 15 cm from distal articular surface.

Fractures Include

1. Closed distal femoral fractures & nonunion
2. Muller type A1 A2 & A3 fractures.
3. Muller type C1 C2 &C3 fractures.
4. Presence of distal 3rd femoral fractures which needs to be internally fixed in displaced Muller's type A and Type C fractures
5. Grade I and Grade II compound injuries
6. Patients who give consent to be included in the study.
7. Patient who is preoperatively mobile.

EXCLUSION CRITERIA

1. AO type B1 B2 & B3 fractures.

2. Grade III open fractures

3. Pathological fractures

4. fractures in children with Skeletal immaturity with open physis.

5.Undisplaced fracture patterns needing only conservative management.

STUDY PROTOCOL

A total of 25 patients with distal femoral fractures were chosen and sampling based on the inclusion and exclusion criteria and included to the study. On admission detailed examination of the patients was carried out after hemodynamic stabilization.. Then standard Antero – Posterior and Lateral view X – Rays are taken and the fracture configuration noted. Patients were initially managed with either Mid tibial pin traction or upper and lower tibial pin traction to immobilize and maintain the length to prevent from shortening Computerized Tomography is also taken when needed to assess the exact alignment of the fragments. The fracture is classified using the Muller classification.

PRE OPERATIVE ASSESMENT:

All basic investigations include complete haemogram, Blood Grouping and Viral markers were carried out .If patients aged more than 50years both

cardiologist and Thoracic physician opinion will be obtained to know cardiac and pulmonary reserve of the patient to withstand surgical procedure.

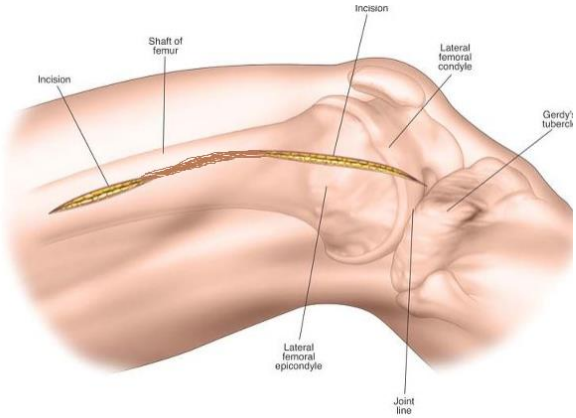
Informed written consent will be obtained from all patients and also consent for bone grafting from iliac crest. Preoperative hemoglobin levels and also amount of blood loss during surgery,based on which Blood Transfusion planned for all patients. Preoperative test dose of antibiotics and test dose of xylocaine will be done. Preparation of both lower limbs up to hip level will be done .All patients electively posted after getting Anesthetic fitness for surgery.

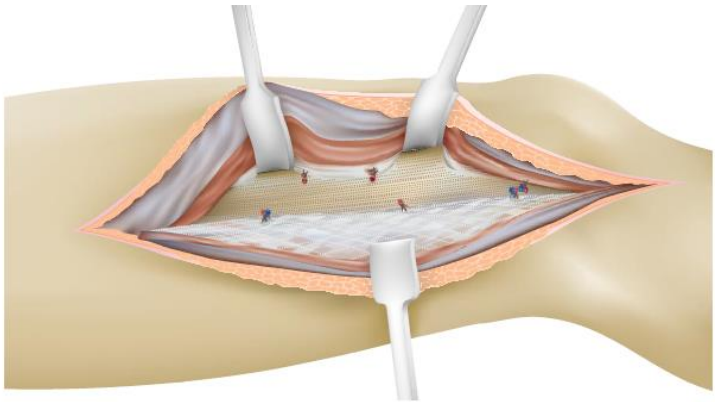
Position Of The Patient[47]:

Both for Locking compression plating and for dynamic condylar screw patients were positioned in supine positions with both lower limbs extended and a small bag placed below the thigh in operative limb to make hip in neutral rotation and also make knee flex to aid in posterior vessels falls away from operative area.

Incision and surgical approaches[47]

Extensile lateral approach widely used all for patients unless special circumstances indicated (type C3 where intra articular reduction directly visualized through swashbuckler anterolateral approach.)





PREREQUISITES[18]

Under spinal Anaesthesia patient positioned supine on the radiolucent table allowing both AP and lateral views. Avoid using fracture table and traction because which create more tension inside the muscles and also difficulty in reducing the fractures. Place a sterile bolster under knee to facilitate exposure and reduction. A sterile tourniquet may be used as a part of procedure. The uninjured limb should be extended. The injured limb is draped so as allow 30-$60^0$of flexion to relax Gastrocnemius muscle. In complex fractures preparation of both the limb was done to achieve correct adjustment and comparison of

length and rotation. A extensile lateral approach is used. A 10-15cm long skin incision is made, Sub cutaneous tissue, vastus lateralis, tensor fascia lata incised till the lateral condyle is reached, reduction of the condyles done using point reduction clamp and image intensifier. Reduction held temporarily using two K wires by avoiding disturbance to plate positioning. The plate along with jig assembly is slid along the shaft using the bevel. The jig plate assembly is held with distal condylar portion with a temporary K wire. The condylar fragment was aligned with metaphyseal fragment by appropriate manipulation (traction and rotation) under image control.

The reduction was held temporarily with k wire, after aligning the plate along the shaft. After confirming the reduction and plate position parallel to the condyles the second K wire passed into the jig, plate and condyle. In this position the anatomically pre bent implant matches the distal femur. The condyles were fixed to the plate using 6.5mm cannulated locking head cancellous screws without disturbing the reduction[7].The reduction and the position of the plate were controlled clinically and by image intensifier help (axis, length, and rotation).The locking head screws inserted using jig sleeve assembly with image intensifier in accordance with pre op planning. The insertion guide is removed and wound is closed over a suction drain. Sterile non bulky dressing applied.

LOCKING COMPRESSION PLATE FIXATION:

The choice of surgical approach is determined by the fracture location and pattern, any associated comminution, the primary reduction techniques, and

the implant. In general, an extensile lateral approach can be used for most supracondylar and inter condylar distal femoral fractures. This approach allows access to the lateral femoral condyle, the inter condylar region, and the entire lateral femur. This approach can be useful for both open plating techniques and minimally invasive techniques. The lateral exposure can be limited to that necessary for reduction of the articular surface in cases where sub muscular techniques are chosen for stabilization of the articular segment to the femoral diaphysis. A lateral para patellar approach may be used in fracture patterns with significant inter condylar comminution, coronal plane fractures, or both. Although this approach allows access to inter condylar comminution, trochlear comminution, and most medial and lateral coronal condylar fractures, it is not as easily extended proximally to allow a lateral plate application on the femoral diaphysis. This approach may be most useful is cases where minimally invasive or percutaneous methods are anticipated for plate application proximally. Infrequently, a medial sub vastus approach may be required in conjunction with a lateral approach. This approach should be limited to the articular segment, respecting the more proximal, medial, soft-tissue attachments. In all surgical approaches, the posterior and medial soft-tissue attachments to any metaphyseal bone segments should be left intact.

DYNAMIC CONDYLAR SCREW FIXATION :

POST OPERATIVE PROTOCOL

POST OPERATIVE CARE AND REHABILITATION

Proper postoperative rehabilitation plays a major role in recovery of range of movement and power the quadriceps mechanism and functions of joint. Rehabilitation should be custom made to the patient and the fracture type, and is easier, more comfortable and more assured with firm internal fixation. If fracture fixation is stable, then therapy can be started early. The most useful range of motion can be achieved, in the first few weeks of postoperative period.

Early Phase (1-3 Weeks)

The primary goal is full range of motion, started on 2nd day, if fixation is stable, emphasizing extension, normal patella mobility, control of edema and pain.

Quadriceps strengthening and hamstring stretching exercises are encouraged. Gentle hip and ankle mobilization exercises are continued.

Continuous passive motion – when started in 1st week has following advantages

1. Improves early range of motion of knee.
2. Decreases incidence of deep vein thrombosis and pulmonary embolus.
3. Faster pain relief and shorter stay at hospital.
4. Better results when used at a rate of 1 cycle per minute, with 40 degrees of maximum flexion for first 3 days.

5. Continuous passive motion reverses collagen loss, improves cartilage nourishment, prevents joint stiffness.

Non – weight bearing with crutches or walker support can be initiated in 1st week, if fixation is stable. Sutures are removed between 10th - 12th postoperative days.

Late Phase (After 3weeks)

Continue isometric quadriceps setting exercises, Active and passive Range motion exercises.

Seated knee extension procedures.

Partial weight bearing is allowed after 3rd week.

Full weight bearing is allowed after radiological evidence of healing. (6-12 weeks).

FOLLOW UP:

All the patients were advised to review for regular follow up in regular interval .Initial 6 weeks they were advised to review every 2 weeks then every month for first 3 months and every 3 months for two years. In each visit their functional outcome analyzed and also good quality digital x ray of the knee with lower thigh taken to assess the union of fractures and see the signs of fracture union,

Functional outcome of all patients analyzed using most versatile Scoring system ,Hospital for Special Surgery,

It has five variables Pain limitations, function of the limb, muscle strength ,range of movements, flexion deformity and substractions for using crutches ,angular deformity and extensor lag. All patients functional outcome analyzed in each visit, since it is retrospective study so we included previously operated patients now they were in state of follow up. These patients all details collected from old hospital records and preoperative and postoperative x rays are collected and stored for future analysis.

Clinical outcome of the patients can be analyzed using many scoring system, Neer Functional Scoring system and Schatzkar Scoring system and Hospital for Special Surgery scoring system.

More versatile and easy to analyze the samples hence we followed the Hospital for Special Surgery scoring system for our study.

SCORING SYSTEM ,HOSPITAL FOR SPECIAL SURGERY (HSS)

Pain - 30 points	
While walking	
None	15
Mild	10
Moderate	5
Severe	0
At Rest	
None	15
Mild	10
Moderate	5
Severe	0

Function - 22points	
A)Walking and Standing UNLIMITED	12
5-10 blocks walking/standing 30 MIN	10
1-5 Blocks walking/standing 15-30 MIN	8
LESS THAN 1 Block/standing <15 Min	4
Cannot walk	0
B)stairs	
Normal	5
With support	2
C)Transfer	
Normal	5
With support	2

Range of Motion	
120 Degrees	15
110 Degrees	14
100 Degrees	12
90 Degrees	11
80 Degrees	10

Muscle strength -15 points	
Gr-5	15
Gr-4	12
Gr-3	9
Gr-2	6
Gr-1	3
Gr-0	0

Flexion deformity -10 points	
None	10
0-10 Degrees	8
10-20 Degrees	5
>20 Degrees	0

Substractions	
Crutches	
One crutch	1
Two crutches	2
Three crutches	3
Extensor lag	
5 degree	2
10 degree	3
15 degree	5
Deformity	
1 point for every 5 degree	
Varus	
Valgus	
Total subtraction	

TOTAL KNEE SCORE	TOTAL POINTS - TOTAL SUBTRACTION
EXCELLENT	85 or MORE
GOOD	70-84
FAIR	60-69
POOR	LESS THAN 60

OBSERVATION

The Patients included in study were evaluated pre operatively and post operatively and instructed to review as stipulated and analyzed as per the following criteria based on their all variables.

1.Age distribution

2.Sex distribution

3.Side of injury

4.Mode of injury

5.Anatomy of injury

6.Grading of injury

7.Subtype of fracture

8.Associated injuries

9.Open fractures

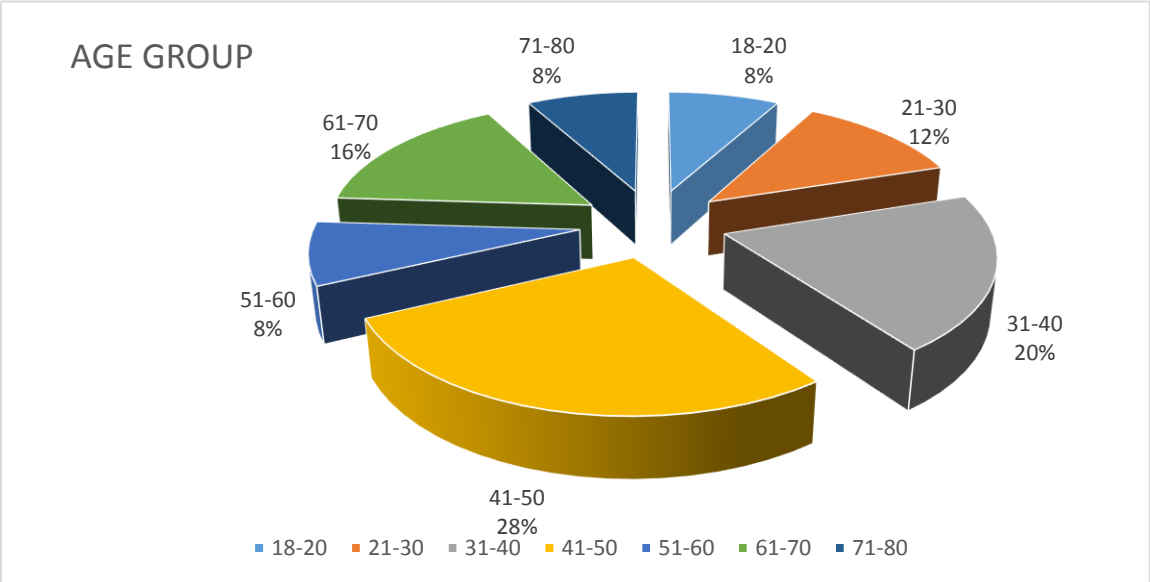
10.Complication

1.AGE DISTRIBUTION

The age groups varied from 18 years to 80 years with the mean age of 44.2 years. Incidence of fracture was observed maximum between 40 – 60 years of age.

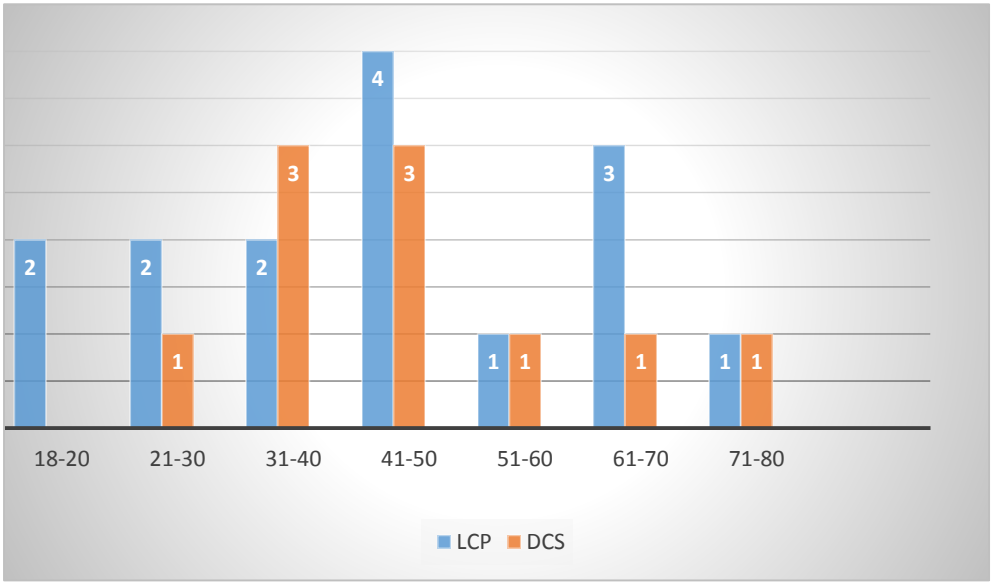
More clusters found in 41-50years.

Age Group	Number of cases	Percentage
18– 20 years	2	8%
21 – 30 years	3	12%
31 – 40 years	5	20%
41 – 50 years	7	28%
51 – 60 years	2	8%
61 – 70 years	4	16%
71 –80 years	2	8%



In our study , age distribution more clusters among the age group of 41-50 years found. Open reduction internal fixation with Locking compression plating done for 15 patients of which 5 patients in 41-50 age group

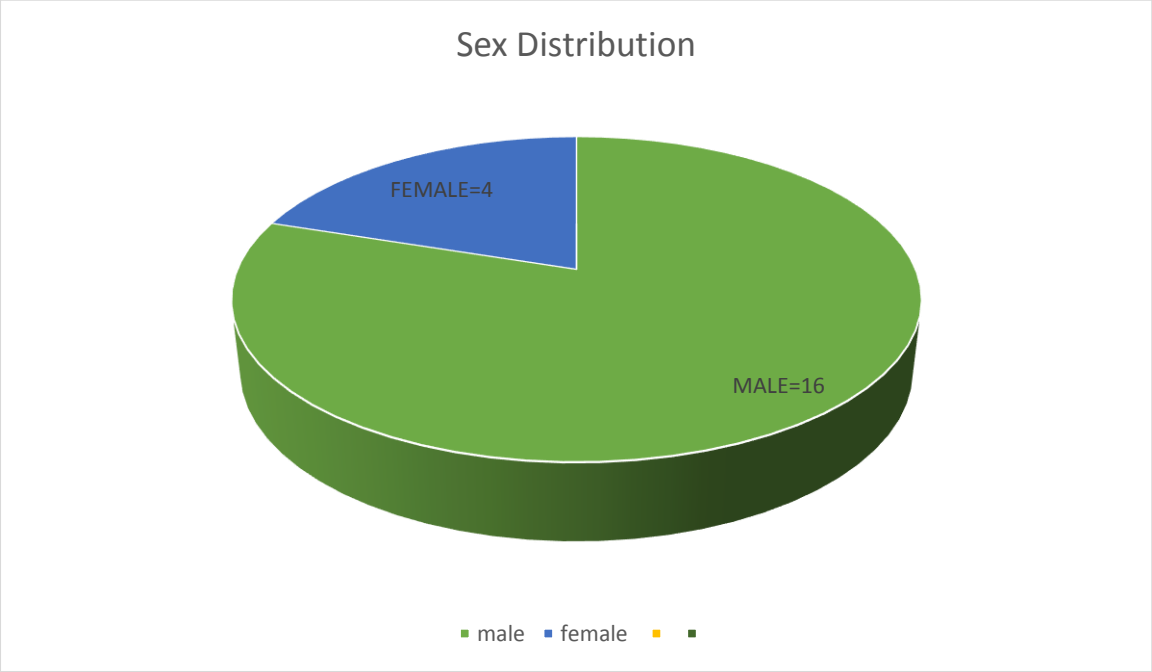
Age Group	**LCP**	**DCS**
18– 20 years	2	-
21 – 30 years	2	1
31 – 40 years	2	3
41 – 50 years	4	3
51 – 60 years	1	1
61 – 70 years	3	1
71 –80 years	1	1



2. SEX DISTRIBUTION

Among the 25 cases, males were predominant with female to male ratio being 1:4.

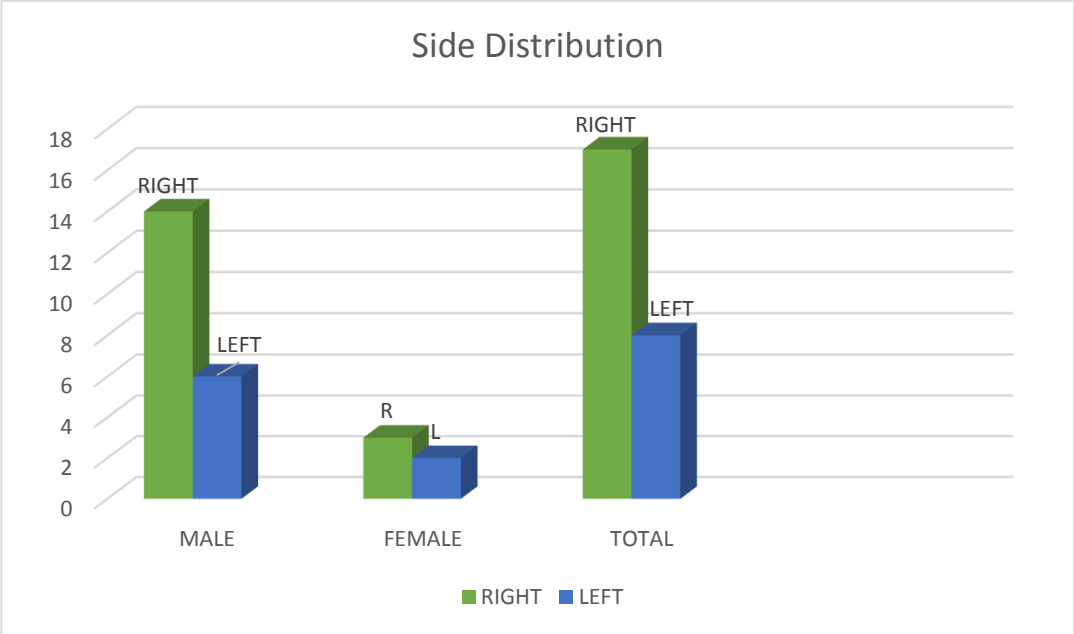
Sex	Number of cases	Percentage
Male	20	80 %
Female	5	20%



3. SIDE OF INJURY:

Right side was common in our series

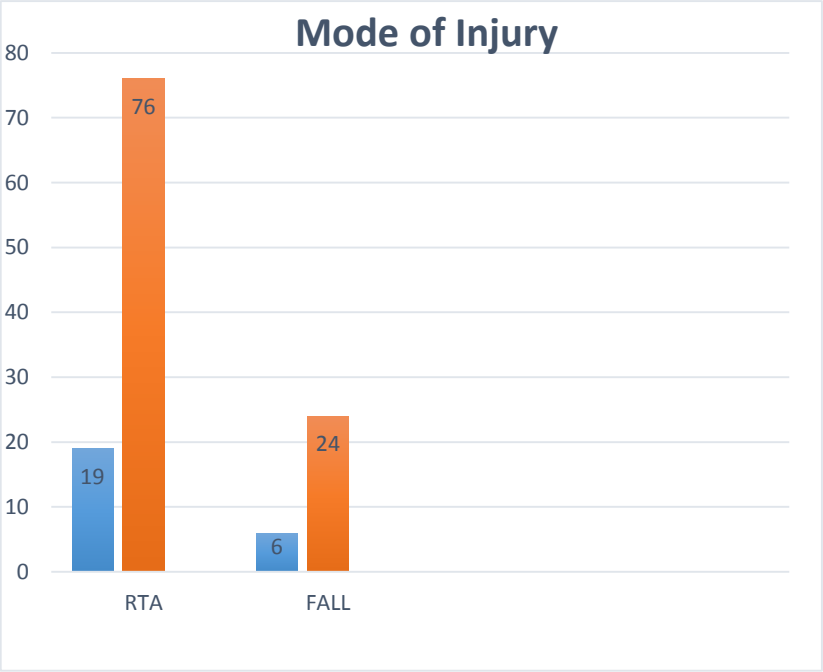
Sex	Right	Left	Total
Male	14	6	20
Female	3	2	5
Total	17	8	25



4. MODE OF INJURY :

Among 25 cases , 19 cases were due to road traffic accidents and 6 cases due to accidental fall .

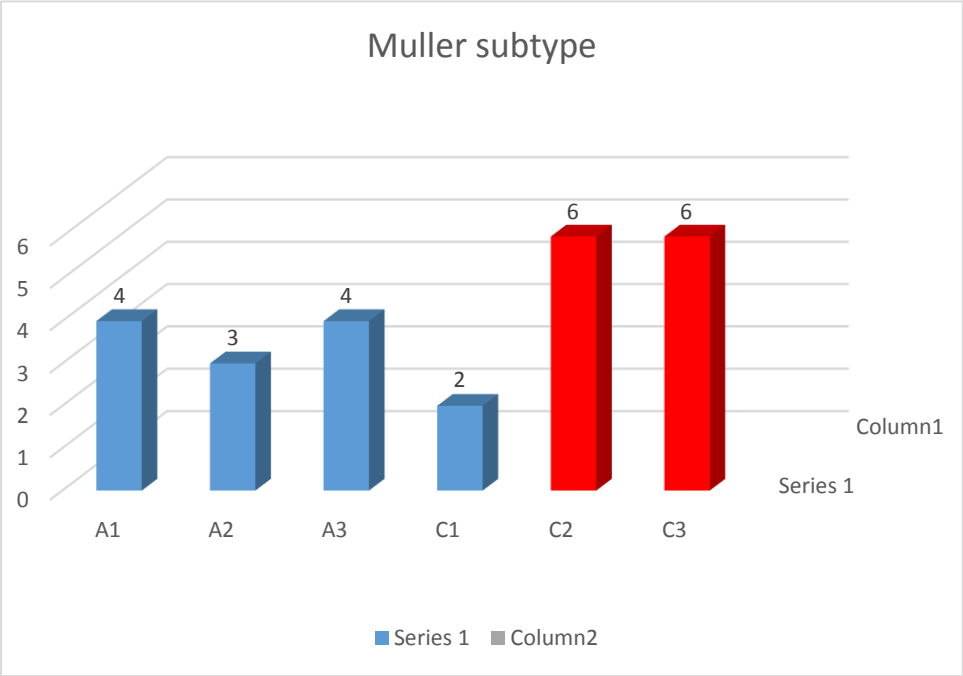
Mode of Injury	Number of cases	Percentage
RTA	19	76 %
Fall	6	24%



5.MULLER SUBTYPE OF FRACTURE

Out of 25 cases fractures, distal femur with inter condylar extension accounted for number of cases followed by isolated supracondylar fractures.

Muller sub type	Number	percentage
A1	4	20%
A2	3	10%
A3	4	10%
C1	2	10%
C2	6	15%
C3	6	25%



6. **ASSOCIATED INJURIES**

Associated injuries mostly involves ipsilateral limb injuries since most cases are due to motor vehicle accidents where involved limb dashed against opposite force causes ipsilateral both bones, proximal femur and posterior dislocations and pelvic injuries and spinal fractures.

Many poly traumatized patients were associated multisystem involvement like multiple rib fractures hemothorax and head injury in the range from diffuse axonal injury to pnemocephalus and intra cranial hemorrhage based upon amount velocity of force of injury.

Head injury – 2

Distal Radius-2

Fracture Both bone leg - 3

Ipsilateral medial malleolus fracture - 1

Tibial plateau – 2

Ipsilateral inferior pubic rami fracture-1

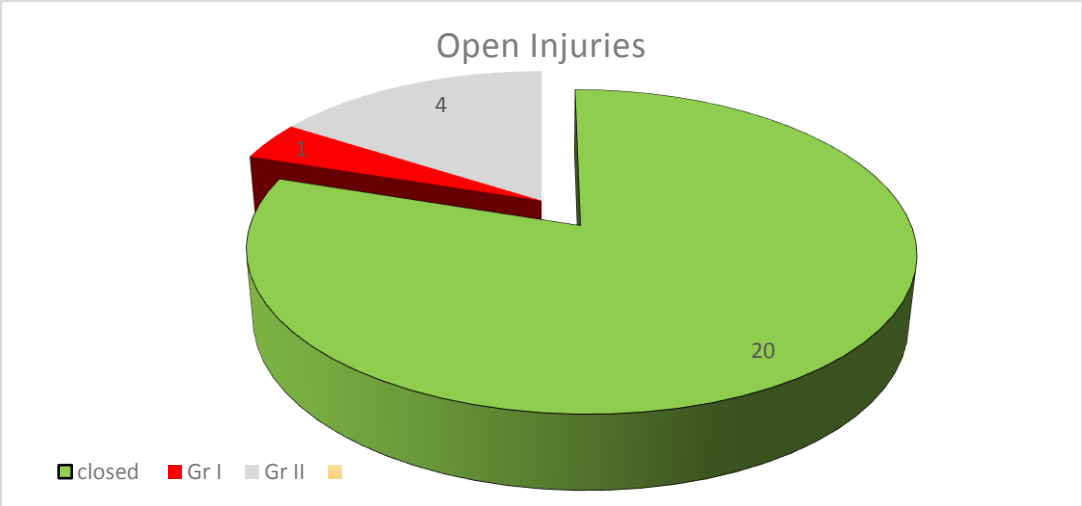
Clavicle fracture-1

7. OPEN FRACTURES

Since our hospital is higher referral center in the state and received cases from all districts and adjacent state, mostly of poly trauma victims with delayed presentation with compound fractures. There were five open fractures, one was compound grade I and other were grade II fracture.

Since compound fractures will affect functional outcome in wound healing, infection, implant failure hence Grade III compound fracture not included in this study. Grade III compound injuries indirectly indicate that high energy and always involves other organs and other bone involvement and affect the functional results.

Gustilo –Anderson Classification	Number of Cases
Closed	20
Grade I	1
Grade II	4



RESULTS AND STATISTICS

In our study, 25 cases of distal femur fracture were operated with Open Reduction with internal fixation with Dynamic Condylar screw and Locking compression plate. 10 patients of distal femur fractures operated with DCS and 15 patients were operated with locking compression plate. Patients were followed up every 3 weeks till fracture united and thereafter at 3 months, 5 months and 1 year. The minimum follow up period in our study was 3 months and maximum follow up period was 12 months.

Clinically, tenderness at fracture site, knee pain, limb length discrepancy, range of movements, any varus or valgus deformity were assessed at each follow up. The results were analyzed with standard anteroposterior and lateral radiographs. Clinical and radiological signs of union were analyzed at each follow up. The fracture was said to be radiologically united if callus was seen in at least 3 cortices in anteroposterior and lateral views. The functional outcomes were analyzed using scoring system of HOSPITAL FOR SPECIAL SURGERY.

Majority of injured patients were males (80%) indicates that males are more involved in outdoor activities and Highest number of patients were in their 4th decade (28%),Road traffic accident was the most common mode of injury (76%) 2 patients had associated distal radius fracture, one

patient had ipsilateral clavicle and one patient had ipsilateral pubic rami fracture, one patient had ipsilateral tibial condyle and 2 patients had ipsilateral tibial shaft fracture making a total of 11 patients (43%) with associated fractures Most of the patients, reported within 1st week of injury to the hospital.20 out of 25 patients had closed injury. Type C2 and C3 muller fracture was the most common fracture type 12 out of 25 patients (48%).The shortest follow up period was 3 months and the longest follow up period was 12 months. The average range of knee flexion achieved was about 0 to 98°.Maximum gain in knee flexion was 120° and minimum gain about 60°.The average knee score 76.55% was rated using HSS functional score.

Early complications were encountered in 4 patients and these were superficial wound infection, wound gaping, pin site infection and mild transfusion reaction. Late complications were observed like mal-union with varus in 3 patients, knee stiffness in 9 patients. The average stay in hospital was about 28days.

Postoperative immobilization with knee brace was advised for severely comminuted fractures, for 3 weeks, although gentle physiotherapy. Exercises were started earlier. Autogenous ipsilateral iliac graft was harvested based on the intra operative on table bone loss, there were used in 10 out of 25 patients. patients were followed at regular

intervals (ie, once in a month for the first 3 months and once every 3 months thereafter).

The minimum follow up period was 3 months and the maximum follow up was 12 months. The mean follow up period in this study was 8.46 months. In our study Average healing of the fractures was 14.5weeks. The mal alignment was found in the cases of intra articular fractures. None had a step > 2mm or more .The average knee flexion in our series was 95 degrees ranging from 15°-120 degrees, the knee flexion varied according to the subtype of the fracture. Shortening less than 1 cm was recorded in 8 cases and shortening of 2 cm and more was recorded in 7 cases. All the patients remained painless in the postoperative period, except for 2 cases which had wound infection. Functionally all the patients discarded walking aid by 16 weeks and one patient was using heel and sole rise.

7 patients treated with Dynamic Condylar Screw for type A Muller fractures showing excellent and good results in 5 patients and poor and bad results in 2 patients. Overall 71.4% for positive and 28.6% of poor results given by DCS, in this same category 4 cases treated with Locking compression screw fixation, all 4 cases good and excellent results. As per HSS Scoring system type A Muller fractures LCP shows outstanding results when compare to DCS.

2 cases in Type A Muller show poor results, of which one case had post operative wound infection, considered as superficial wound infection and

treated with parentral antibiotics. Patients discharged after wound found to be silent and healthy. He didn't come for follow up for first 3 months. After 4th month of follow up presented with infected wound and sprouting granulation tissue from the operative scar and diagnosed as infected Implant and Wound debridement and implant exit done. Fracture found be in good alignment and sticky he treated with supportive posterior splint and appropriate antibiotics. Another patient had varus deformity of the operated limb and FFD of 30 and knee stiffness.

Out of 25 patients 14 had type C Muller fractures of which 3 patients were treated with DCS and 11 Patients were treated with LCP. 6 patients out of 11 shown excellent and good results and 5 patients shown poor results.

3 patients of DCS one patient shown good results and 2 shown poor results.

Overall comparative results in concern with type C intra articular fractures treated with LCP and DCS, LCP shown comparatively good functional outcome in 55 % patients and DCS shown 33 % good results and 67% poor results. Of the 5 patients who shown poor and fair outcome mainly of C3 type with highly comminuted intra articular involvement with knee stiffness and knee pain and varus and valgus deformity. Superficial wound infection found in the patient who treated with DCS, which was treated appropriate antibiotics and physiotherapy.

VARIABLE	SCORE	NO OF PATIENTS
Pain	4	13
	3	3
	2	5
	1	4
Movements (In degrees)	4	12
	3	6
	2	4
	1	3
Function	4	13
	3	8
	2	3
	1	1
Shortening	3	12
	2	9
	1	4
Angulation	3	16
	2	6
	1	3

RESULTS ACCORDING TO SUBTYPE OF MULLER CLASSIFICATION

MULLER'S SUB TYPE	FUNCTIONAL OUTCOME SCORE LCP Vs DCS							
	EXCELLENT		GOOD		FAIR		POOR	
	LCP	DCS	LCP	DCS	LCP	DCS	LCP	DCS
A1	1	2	-	-	-	1	-	-
A2	-	1	-	1	-	-	-	1
A3	2	-	1	1	-	-	-	-
C1	-	-	1	1	-	-	-	-
C2	1	-	2	-	1	1	1	-
C3	1	-	1	-	3	1	-	-
TOTAL	8		8		7		2	

Comparative study significance:

Excellent and Good Results=16/25=64%

Fair and Poor Results=9/25=36%

Excellent and Good Results in LCP10 Out Of 15=66.66%

Fair and Poor Results in LCP=5 Out Of 15=33.33%

Excellent and Good Results in DCS=6 Out Of 10=60%

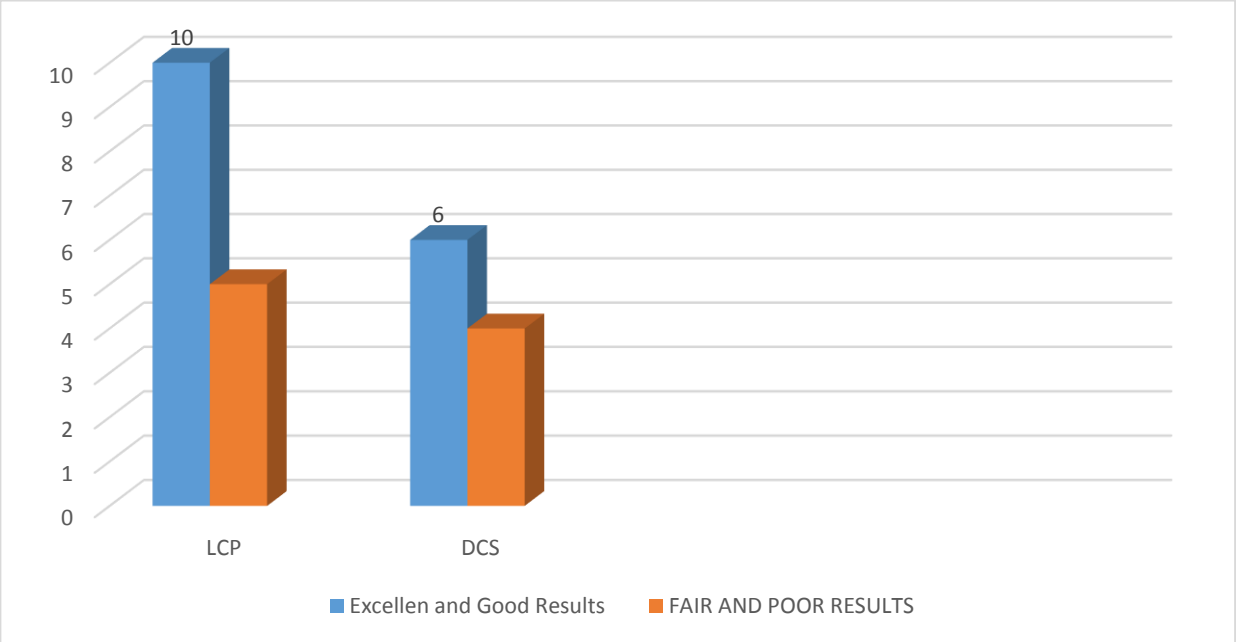
Fair and Poor Results in DCS =4 Out Of 10=40%

CHI –SQUARE TEST OF SIGNIFICANCE –

‘P’ VALUE DETERMINATION

	Excellant and Good Outcome	Fair and Poor Results	*Marginal Row Totals*
Locking Compression Plating	10 (9.6) [0.02]	5 (5.4) [0.03]	15
Dynamic Condylar Screw fixation	6 (6.4) [0.03]	4 (3.6) [0.04]	10
Marginal Column Totals	16	9	25 (Grand Total)

The Chi-square statistic is 0.1157. The P value is 0.733701. This result is *not* significant at $p < 0.05$.

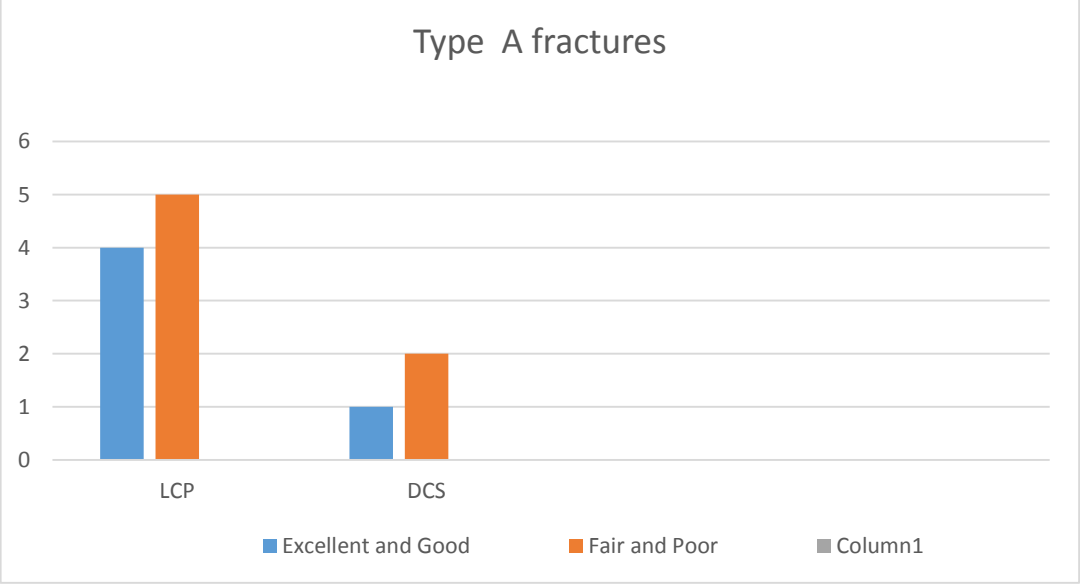


COMPARATIVE RESULTS ACCORDING TO MULLER TYPE A FRACTURES

Study Group	LCP Group	DCS Group
Excellent	3	3
Good	1	2
Fair	0	1
Poor	0	1

	Type A Muller with LCP	Type A Muller with DCS	*Marginal Row Totals*
Excellant and Good Results	4 (3.27) [0.16]	5 (5.73) [0.09]	9
Fair and Poor Results	0 (0.73) [0.73]	2 (1.27) [0.42]	2
Marginal Column Totals	4	7	11 (Grand Total)

The Chi-square statistic is 1.3968. The P value is 0.237256. This result is *not* significant at p < 0.05.



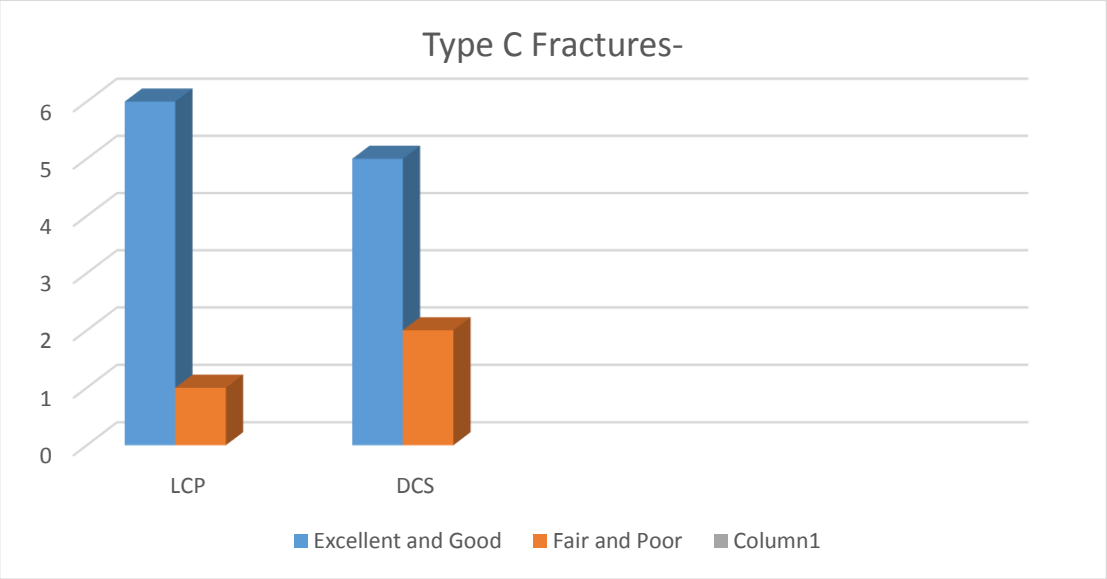
COMPARATIVE RESULTS ACCORDING TO

MULLER TYPE C FRACTURES

Study Group	LCP Group	DCS Group
Excellent	2	0
Good	4	1
Fair	4	1
Poor	1	1

	Muller Type C fractures with LCP	Muller Type C fractures with DCS	*Marginal Row Totals*
Excellent and Good Outcome	6 (5.5) [0.05]	1 (1.5) [0.17]	7
Fair and Poor Outcome	5 (5.5) [0.05]	2 (1.5) [0.17]	7
Marginal Column Totals	11	3	14 (Grand Total)

The Chi-square statistic is 0.4242. The P value is 0.514828. This result is *not* significant at $p < 0.05$.



DISCUSSION

Treatments of the distal femoral fractures have been a controversial subject over the decade [37,38,39]. There have been changing philosophies towards surgical treatment of supra condylar fractures of femur. Close management of these fractures was the treatment of choice until 1970. This was due to non-availability of appropriate implants and lack of proper techniques. Apart from the usual problems of confining elderly patient to bed, conservative methods at any age may be complicated by knee stiffness, mal union and nonunion.

Early surgical stabilization can facilitate care of the soft tissue, permit early mobility and reduces the complexity of nursing care. Open reduction and internal fixation has been advocated, using implants, including angled blade plate, fickle devices, Rush rods, Ender nails, Dynamic condylar screw, condylar buttress plate and interlocking nails, locking compression plate.

The use of fixed angle devices such as condylar blade plate along with dynamic condylar screw (DCS) require certain amount of good bone stock should be there to insert Lag screw and also its entry makes significant amount of bone loss from lag screw entry site which itself compromise already fractured condyles hence it limits their use in some fracture type of intra articular fracture. This lead to the development of condylar buttress

plates for comminuted fractures. However with standard buttress plating, these fractures often fall into varus deformity.

Biomechanical studies revealed that gross loosening of standard condylar buttress plate and DCS occurred because of the toggle at the screw-plate interface, which leads early implant loosening results in breakage of implant and varus /valgus collapse of distal fragment. To address these issues, a first generation locking condylar plate was designed

A locking plate decreases the screw-plate toggle and motion at the bone-screw interface and provides more rigid fixation [6,7,8,9]. Rigid fixation is felt to be one key to the successful treatment of these fractures .The conventional plates are associated with their own demerits such as screw pullout, implant failure and unstable fixation needing postoperative immobilization[8].

Delay in postoperative mobilization results in stiffness of the knee which is an indicator of poor outcome. Fixation in osteoporotic and comminuted fractures which was difficult previously was addressed with the invention of locking condylar buttress plate. So now with the evolution of locking compression plating for distal femoral fractures especially for the comminuted intra – articular fractures many of the older demerits could be addressed which includes the *increased stability due to locking compression plating principle, multiple screw options in the distal fragment providing option for fixing the multiple fragments restoring the*

anatomical congruity and providing stable fixation of the distal fragment with the proximal fragment with resulting increased stability allowing for early mobilization.

Current fracture patterns which we encounter are complex comminuted types due to the prevalence of high speed vehicles mainly due to the high two wheeler population in countries like India. Improved healthcare results in a longer life span and subsequently presents us with more osteoporotic fractures which were previously treated using conservative methods.

The LCP is a single beam construct where the strength of its fixation is equal to the sum of all screw-bone interfaces rather than a single screw's axial stiffness and pullout resistance in unlocked plates[30]. *Its unique biomechanical function is based on splinting rather than compression resulting in flexible stabilization, avoidance of stress shielding and induction of callus formation. It can also be used as biological fixation without disturbing the fracture site.*

The Distal Femur-LCP is a further development from the LISS, which was introduced in the mid to late 1990' The main difference between the Distal Femur-LCP and the LISS is that the LISS utilizes an outrigger device for shaft holes, functioning essentially as a locking guide jig, which is attached to the distal part of the plate and guides the placement of the proximal locking screws. The shaft holes on the Distal Femur-LCP are oval allowing for the options of a compression screw or a locking screw. This leads to a

more precise placement of the plate, as it is able to be compressed more closely to the bone. Although Distal Femur-LCP is designed to fit the anatomy of the distal femur, we were worried about the fit in our local Asian population where shorter and smaller femurs are the norm. During fixation in delayed cases especially if there was severe comminution maintaining the reduction in good alignment and applying the initial screw were difficult. The average time of union was 15.3 weeks which is similar to the other modes of fixation and there is no additional benefit of early healing. However, thus far, our limited numbers demonstrate that this is not an issue.

Comparable studies utilizing the Distal femur LCP demonstrate only short term results. Although the follow-up period of our series was short, studies have shown that early function is comparable to final long term outcome. The outcome seems to correlate with fracture severity, anatomic reduction, etiology, bone quality, length of time elapsed from injury to surgery, concomitant injuries and the exact positioning and fixation of the implant. Furthermore, the initial severe concomitant cartilage damage may predispose to early osteoarthritis although there is no evidence of that yet[33]

COMPARISON WITH OTHER STUDIES [43 ,44,45]

AUTHOR	Sample size	Open Injuries %	Type A %	Type C %	Age	Follow up Months	ROM	Deep infection	Implant Failure	Outcome
Kregor et al	66	NA	50	50	49	9	2-103	3	1.5%	-
Schutz et al	99	29	67	33	54	13.7	0-107	7	6	-
Mark miller et al	207	NA	50	50	57	12	0-110	-	10	87.5
Apostolou et al	19	20	30	55	54.5	16	0-108	5		81.25
Yeap and deepak et al	11	36	55	45	44	9.7	10-107.7	9		72.7
Our study LCP	15	26	27	73	44.2	7.46	10-98	1		76.06

Of the 25 male cases 19 cases were due to RTA while travelling in a two wheeler. Of the 19 cases, 14 cases (i.e., 73.6%) involved the dominant Right side which shows that the increased two wheeler population and the left sided driving regulation are to be blamed for. One patient who had Type A2 Muller fracture treated with DCS, immediate post op went well without any specific complaints but after 5months follow up present with discharging wound and

warmth from distal scar, it was communicated with deep structures. Pus culture sensitivity has been sent and fracture alignment maintained in acceptable position and hence planned for wound debridement and implant exit was done and temporarily he advised with Above Knee Cast after which fracture got united and Fair result was obtained.

DCS Infected

There were four fair results. The first one was an implant failure. The fracture was in good alignment even after implant failure and hence conservative management with AK cast was done and resulted in a Fair result. The second one was the one with Muller's Type C3 fracture with severe comminution fixed with LCP had decreased postoperative knee mobility.

The last case was the one who had concomitant ipsilateral proximal tibia # which was planned for conservative management with AK cast for 3 months didn't allow for early mobilization and hence the outcome was fair.

In Muller's C2 and C3 fractures due to the multiple screw options multiple fragments can be reduced with improved stability which cannot achieved by using the conventional DCS which uses only one large lag screw. Also revision surgery can be done easily in LCP whereas in DCS if a revision surgery is planned the removal of the lag screw leaves a cavity in the condylar area which renders it difficult for fixation and even if fixation is done chances of failure is more due to poor bone stock..Varus mal alignment was one of the complication which was encountered during the initial phase of the study. In the later phase of the study Varus mal alignment was low due to the technique of maintaining gap between the plate and the proximal fragment and hence the good alignment was maintained. Also using lengthier plates rather than using small plates resulted in reduced rate of this complication in the later part of the study.

When comparing infection rates among LCP and DCS, both showing similar functional results but statistically slightly higher values among DCS, this could be attributed relatively large amount bone has been removed while inserting lag screw and relative prominence of blade screw junction.

THE CONCLUSIONS OF THIS STUDY ARE

- Fractures of distal femur are more common in high velocity injuries and occur in middle aged men and old age women. Most fractures were comminuted. Locking compression plate [LCP] appears to be technically an ideal implant for comminuted distal femoral fractures with proper physiotherapy produced excellent results.

- Dynamic condylar screw [DCS]appears to be relatively easy construct to fix in the distal femur fracture, however bulky implant, mandatory of 2 to 4cm Intact femoral condyle for lag screw insertion and varus collapse of medial fragment in case of comminuted fractures, made this good implant only for Muller type A, and type B.

- In Type C comminuted intra articular distal femur fractures LCP superior to DCS in functional outcome. In Type A,B fractures both LCP and DCS ,produced similar functional results.

- Infection, knee stiffness and mal alignment of fractures were the common complication we encountered in our series in both LCP and DCS, of which comparative analysis shows relatively higher incidence complications found in the DCS, which could be tackled by surgical

expertise, meticulous soft tissue handling, judicious use of antibiotics and vigorous early knee mobilization.

- In conclusion locking compression plate [LCP] produces better results and appears to be a good method of choice for management of fractures of distal femur.
- However, Large study sample and long term follow up needed for accurate analysis of functional outcome of this fractures.

CASE ILLUSTRATION: CASE NO-1

1.Patient :	Mrs.Saramma
2.Age /Sex:	65 Female
3.IP No:	65829
4.Mode of Injury:	Fall
5. Muller Type:	A1-Right side-Closed
6. Initial Treatment :	MTPT
7.Management:	Locking Compression Plate
8.Anesthesia:	Spinal
9.Union in Weeks:	12weeks
10.Follow up :	12months
11.Range of Movements:	10-120degrees
12.Complications:	-
13.Functional Outcome Score (Hospital for Special Surgery-HSS) :	90
14.Outcome:	Excellent

Pre op

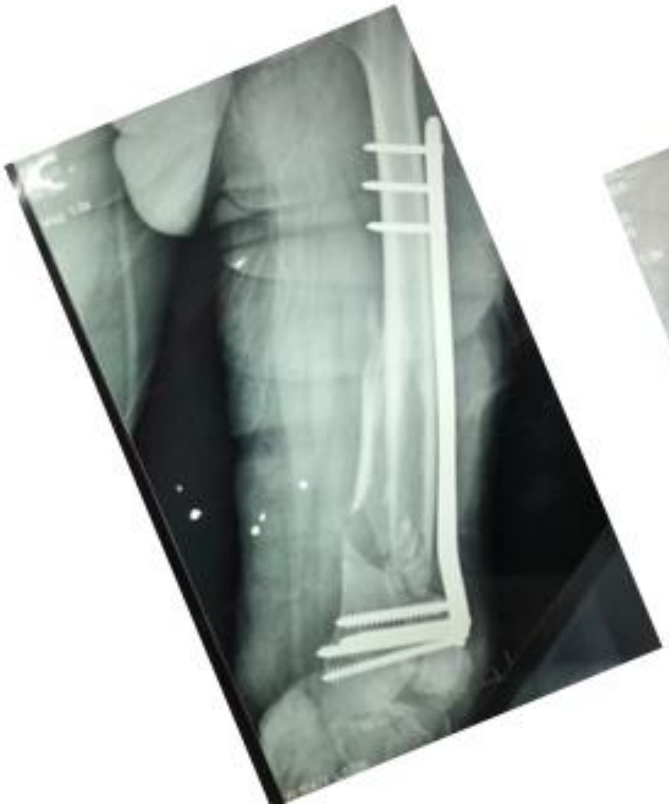
11 month follow up

CASE ILLUSTRATION : CASE NO-2

1.Patient :	Mrs.Kanniyammal
2.Age /Sex:	48F
3.IP No:	36772
4.Mode of Injury:	Road Traffic Accident
5. Muller Type:	C2 Left side Closed
6. Initial Treatment :	Mid Tibial Pin traction
7.Management:	Locking Compression Plating
8.Anesthesia:	Spinal
9.Union in Weeks:	18weeks
10.Follow up :	4 and half months
11.Range of Movements:	30-90degrees
12.Complications:	Knee Stiffness Shortening 2cm
13.Functional Outcome Score (Hospital for Special Surgery-HSS) :	60
14.Outcome:	Poor

PRE OPERATIVE X RAYS

IMMEDIATE POST OP



4months post

FLEXION 30-90

KNEE STIFFNESS

CASE ILLUSTRATION: CASE NO-3

1.Patient :	Mr.Shanmugam
2.Age /Sex:	52 MALE
3.IP No:	56394
4.Mode of Injury:	Road Traffic Accident
5. Muller Type:	C1-Right side-Closed
6. Initial Treatment :	High AK Slab
7.Management:	Dynamic Condylar Screw
8.Anesthesia:	Spinal
9.Union in Weeks:	14weeks
10.Follow up :	6 months
11.Range of Movements:	30-90degrees
12.Complications:	-
13.Functional Outcome Score (Hospital for Special Surgery-HSS) :	86
14.Outcome:	Excellent

Pre op

Immediate Post op

6months Follow up

FLEXION-0-120

CASE ILLUSTRATION: CASE NO-4

1.Patient :	Mr.Jayaseelan
2.Age /Sex:	40 MALE
3.IP No:	90564
4.Mode of Injury:	Road Traffic Accident
5. Muller Type:	C2-Right side-Gr II open
6. Initial Treatment :	External Fixation
7.Management:	Locking Compression Plate
8.Anesthesia:	Spinal
9.Union in Weeks:	16weeks
10.Follow up :	8 months
11.Range of Movements:	0-100degrees
12.Complications:	-
13.Functional Outcome Score (Hospital for Special Surgery-HSS) :	88
14.Outcome:	Excellent

Pre op

Immediate Post op

7months Post op

Flexion 0-100 degree

CASE ILLUSTRATION –CASE NO -5

1.Patient :	Mr.Chandran
2.Age /Sex:	48 MALE
3.IP No:	72807
4.Mode of Injury:	Road Traffic Accident
5. Muller Type:	C2-Left side-Closed
6. Initial Treatment :	UTPT
7.Management:	Locking Compression Plate
8.Anesthesia:	Spinal
9.Union in Weeks:	16weeks
10.Follow up :	9 months
11.Range of Movements:	15-70degrees
12.Complications:	Knee stiffness
13.Functional Outcome Score (Hospital for Special Surgery-HSS) :	72
14.Outcome:	GOOD

PRE OP XRAY

IMMEDIATE POST OP XRAYS

9 MONTHS POST OP

FLEXION – 15 TO 75

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ABBREVIATIONS

AO – Albeitgemeinschaft fur Osteosynthesefragen

ASIF - Association for the Study of Internal Fixation

CBP – Condylar Blade Plate

ORIF – Open Reduction and Internal Fixation

DCS – Dynamic Condylar Screw

GSH – Green Seligson Henry

LCP-Locking Compression Plate

LISS-Less Invasive Skeletal Stabilization

ORIF-Open Reduction Internal Fixation

ROM-Range Of Movements

AP-Antero Posterior

PROFORMA

Case No:…… Unit:……
Name:…….…… Age/Sex:…..…
I.P No:……Occupation:……..
Address:……
……
Phone:……
Date of injury : ……
Date of admission: ……..
Date of definitive surgery:/……
Date of discharge: ……./……/……
Mechanism of injury
a. Road traffic accident
b. Accidental fall
c. Industrial accident
d. Assault with weapon
Severity of injury:
High velocity
Moderate velocity
Trivial
General condition:
1) Conscious
2) Drowsy
3) Unconscious
Haemodynamic status:
a. Stable (Systolic BP>110 mmHg, PR<90/min)
b. Moderately stable (Systolic BP 70 to 90 mmHg, PR
90 to 110/min)
c. Unstable (Systolic BP<70 mmHg, PR>110/min)
Side involved: (Right/Left)

Type of injury:
Closed
Open
Grade I
Grade II
Grade III A
Grade III B

X ray findings:
Type of the fracture:
Type A: Extra-articular
A1: simple # of metaphysic
A2: metaphyseal wedge #
A3: complex metaphyseal#

Type B: Partial-articular
B1: lateral condylar # in sagittal plane
B2: medial condylar # in sagittal plane
B3: # of condyle in frontal plane

Type C: Complete articular
C1: simple # of both the articular surface and the metaphysic
C2: simple # of articular surface, multi fragmentary at metaphysic
C3: multi fragmentary # of articular surface

Associated other long bone injuries: (Yes/No)

Associated head injury: (Yes/No)

Treatment history:

Treatment elsewhere if any:

Treatment in our institution:

Initial management:

Time interval between injury and initial management :

Procedure done :

Time interval :

Bone grafting : (Yes / No)

Blood transfusion : (Yes / No)

Intraoperative events and difficulties :

Stability of fixation :

Immediate post operative events

Complications :

Post operative immobilization :

Post operative alignment

Limb length discrepancy

Other injuries if any and their management :

INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE, CHENNAI-3

EC Reg No.ECR/270/Inst./TN/2013
Telephone No. 044 25305301
Fax : 044 25363970

CERTIFICATE OF APPROVAL

To
Dr.N.Vinothkumar,
Post Graduate, MS (Orthopaedics),
Institute of Orthopaedics and Traumatolgy,
Madras Medical College,
Chennai – 600 003.

Dr.N.Vinothkumar,

The Institutional Ethics Committee has considered your request and approved your study titled **"Comparative analysis of functional outcome of distal femoral fractures treated with locking compression plate and dynamic condylar screw"** No.1807 2014.

The following members of Ethics Committee were present in the meeting held on 01.07.2014 conducted at Madras Medical College, Chennai-3.

1. Dr.C.Rajendran, M.D.,	: Chairperson
2. Dr.R.Vimala, M.D., Dean, MMC, Ch-3	: Deputy Chairperson
3. Prof.B.Kalaiselvi, M.D., Vice-Principal, MMC, Ch-3	: Member Secretary
4. Prof.R.Nandhini, M.D., Inst.of Pharmacology, MMC	: Member
5. Dr.G.Muralidharan, Director Incharge, Inst.of Surgery	: Member
6. Prof.Md.Ali, M.D., D.M., Prof & HOD of MGE, MMC	: Member
7. Prof.K.Ramadevi, Director i/c, Inst.of Biochemistry, MMC	: Member
8. Prof.Saraswathy, M.D., Director, Pathology, MMC, Ch-3	: Member
9. Prof.Tito, M.D., Director i/c, Inst.of Internal Medicine, MMC	: Member
10.Thiru S.Rameshkumar, Administrative Officer	: Lay Person
11.Thiru S.Govindasamy, B.A., B.L.,	: Lawyer
12.Tmt.Arnold Saulina, M.A., MSW.,	: Social Scientist

We approve the proposal to be conducted in its presented form.

Sd/ Chairman & Other Members

The Institutional Ethics Committee expects to be informed about the progress of the study and SAE occurring in the course of the study, any changes in the protocol and patients information/informed consent and asks to be provided a copy of the final report.

Member Secretary, Ethics Committee

MEMBER SECRETARY
INSTITUTIONAL ETHICS COMMITTEE
MADRAS MEDICAL COLLEGE
CHENNAI-600 003

ஆய்வு தகவல் தாள்

ஆராய்ச்சியாளர் பெயர்: மரு.நா.வினோத் குமார்

தலைப்பு : தொடை எலும்பின் கீழ் பகுதியில் (DISTAL FEMUR) ஏற்படும் எலும்புமுறிவிற்கு LOCKING COMPRESSION PLATE என்ற புதிய வகை தட்டு மற்றும் DYNAMIC CONDYLAR SCREW என்ற உபகரணத்தை பொறுத்தி அறுவை சிகிச்சை மேற்கொண்டு ஏற்படும் செயல்பாட்டு விளைவுகளை ஒப்பிடும் மருத்துவ ஆய்வு.

சென்னை அரசு பொது மருத்துவமனையில் தொடை எலும்பின் கீழ் பகுதியில் ஏற்படும் எலும்புமுறிவிற்கு சிகிச்சைக்கென சேர்க்கப்படும் நோயாளிகளில் மேற்கொள்ள படும் மருத்துவ ஆய்வு .
இந்த மருத்துவ ஆய்வின் நோக்கம் தொடை எலும்பின் கீழ் பகுதியில் ஏற்படும் எலும்புமுறிவிற்கு LOCKING COMPRESSION PLATE என்ற தட்டு மற்றும் DYNAMIC CONDYLAR SCREW என்ற உபகரணத்தை பொறுத்தி அறுவை சிகிச்சை மேற்கொண்டு ஏற்படும் செயல்பாட்டு விளைவுகளை ஒப்பிடுதல் ஆகும்.
ஊடு கதிர் நிழற் படம் எடுத்து சில குறிப்பிட்ட வகையான எலும்பு முறிவு கொண்ட நோயாளிகள் மட்டும் ஆய்வுக்கு எடுத்து கொள்ளப்படுவார்கள்.
தேர்த்தெடுக்கப்பட்ட நோயாளிகள் மயக்க மருந்து நிபுணர் ஒப்புதல் பிறகு தட்டு பொறுத்தி அறுவை சிகிச்சை மேற்கொள்ளப்படுவார்கள்.
அறுவை சிகிச்சை க்கு பின் ஊடு கதிர் நிழற் படம் எடுத்தும், வலி மற்றும் முட்டியை மடக்கும் திறன் ,கீழே அமரும் திறன் நடக்கும் திறன் வைத்து ஆராய்ந்து ஒப்பிட படுவார்கள்
மேலும் அறுவை சிகிச்சைக்கு பின் ஒன்று இரண்டு மூன்று மாதங்களில் அறுவை சிகிச்சை கா யம் மற்றும் ஊடு கதிர் நிழற் படம் எடுக்கப்பட்டு எலும்பு முறிவு சேர்ந்து விட்டதா என்றும், வலி மற்றும் முட்டியை மடக்கும் திறன் ,கீழே அமரும் திறன் நடக்கும் திறன் வைத்து ஆய்வுகள் மேற்கொள்ள படும்.
மேலும் இதற்கு முன்னால் நடந்த ஆய்வில் எந்த பின் விளைவுகளும் இல்லை என்று உறுதி படுத்த பட்டுள்ளது
மேலும் நோயாளிகளின் பெயர் மற்றும் அடையாளங்கள் மருத்துவ ஆய்வின் போதோ முடிவுகளின் போதோ வெளியிட மாட்டோம் என்று தெரிவித்துகொள்கிறேன்.

பங்கு பெறுபவர் பெயர்: ***ஆய்வாளர் பெயர்:***

இடம்: ***தேதி :***

PATIENT INFORMATION SHEET

TITLE OF THE STUDY : **"COMPARTIVE ANALYSIS OF FUNCTIONAL OUTCOME OF DISTAL FEMUR FRACTURES TREATED WITH LOCKING COMPRESSION PLATE AND DYNAMIC CONDYLAR SCREW"**,

We are conducting a study on **"Comparative Analysis Of Functional Outcome Of Distal Femur Fractures Treated With Locking Compression Plate And Dynamic Condylar Screw"**, among patients admitted in the Institute of Orthopaedics & Traumatology, Rajiv Gandhi Government General Hospital, Chennai.

The purpose of this study is to evaluate and analyse the clinical, radiological and functional outcome of distal femur fractures treated with locking compression plate and dynamic condylar screw.

We are selecting certain cases based on radiographic pattern of distal femur fractures and if they are found eligible, we perform surgical procedure for the fractured limb by locking compression plate and dynamic condylar screw technique or if they are all already operated for the fracture by the above mentioned technique we will evaluate the outcome of surgery, which in any way do not affect your final report or management.

The privacy of the patients in the research will be maintained throughout the study. In the event of any publication or presentation resulting from the research, no personally identifiable information will be shared.

Taking part in this study is voluntary. You are free to decide whether to participate in this study or to withdraw at any time; your decision will not result in any loss of benefits to which you are otherwise entitled.

The results of the special study may be intimated to you at the end of the study period or during the study if anything is found abnormal which may aid in the management or treatment.

Signature of Investigator Signature of Participant

Date :

PATIENT CONSENT FORM

Study Detail	:	Comparative Analysis of Functional Outcome of Distal femur fractures treated with Locking Compression and Dynamic Condylar Screw fixation
Study Centre	:	Rajiv Gandhi Government General Hospital, Chennai.
Patient's Name	:	
Patient's Age	:	
Identification Number	:	

Patient may check (√) these boxes

a) I confirm that I have understood the purpose of procedure for the above study. I have the opportunity to ask question and all my questions and doubts have been answered to my complete satisfaction. ☐

b) I understand that my participation in the study is voluntary and that I am free to withdraw at any time without giving reason, without my legal rights being affected. ☐

c) I understand that sponsor of the clinical study, others working on the sponsor's behalf, the ethical committee and the regulatory authorities will not need my permission to look at my health records, both in respect of current study and any further research that may be conducted in relation to it, even if I withdraw from the study I agree to this access. However, I understand that my identity will not be revealed in any information released to third parties or published, unless as required under the law. I agree not to restrict the use of any data or results that arise from this study. ☐

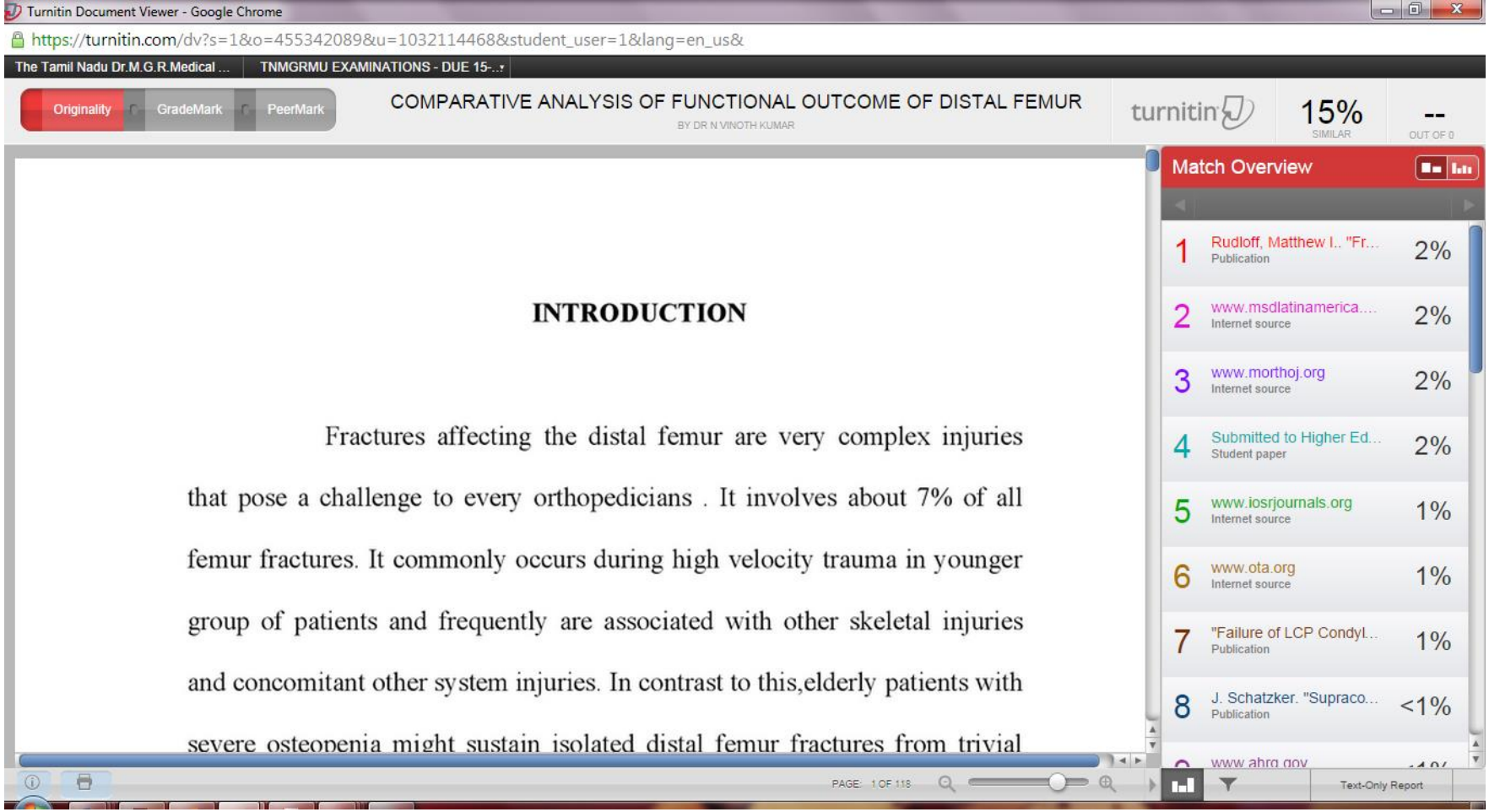
d) I agree to take part in the above study and to comply with the instructions given during the study and faithfully cooperate with the study team and to immediately inform the study staff ☐

if I suffer from any deterioration in my health or well being or any unexpected or unusual symptoms.

e) I hereby consent to participate in this study. ☐

f) I hereby give permission to undergo detailed clinical examination, Radiographs ,blood investigations and surgical procedure as required. ☐

Signature/thumb impression	Signature of Investigator
Patient's Name and Address:	Study Investigator's Name: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INTRODUCTION
Fractures affecting the distal femur are very complex injuries that pose a challenge to every orthopedicians . It involves about 7% of all femur fractures. It commonly occurs during high velocity trauma in younger group of patients and frequently are associated with other skeletal injuries and concomitant other system injuries. In contrast to this,elderly patients with severe osteopenia might sustain isolated distal femur fractures from trivial
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INTRODUCTION

MASTER CHART

Case No	Name	Age	Sex	IP No	Mode OfInjury	Type	Open Injury	Affected Side	Initial Treatment	Definitive Treatment	Union In	Rom Flexion	KneeScore	Complication	Follow Up in months	Outcome
1	Chandran	48	M	72807	RTA	Muller C2	Closed	Left	UTPT	LCP	16	15-70	72	2cm shortening	9months	Good
2	santhanam	65	M	34953	RTA	Muller C2	closed	Right	AK Slab	LCP	18	20-95	70	-	7months	Good
3	Kanniyammal	48	F	36772	RTA	Muller C2	closed	Left	MTPT	LCP	18	30-90	60	Knee stiffness Shortening	5months	Poor
4	Shanmugam	52	M	56394	RTA	Muller C1	closed	Right	AK Slab	DCS	14	0-120	86		6Months	Excellent
5	Jayaseelan	40	M	90564	RTA	Muller C2	Gr II	Left	Ext fixation	LCP	16	0-100	88	-	8Months	Excellent

6	Arjunan	45	M	35094	RTA	Muller A3	closed	Right	AK Slab	DCS	12	10-90	80	2cm Shortening	4months	Good
7	Durairaj	40	M	120446	RTA	Muller C1	closed	Right	MTPT	LCP	14	20-90	74	-	6Months	Good
8	Shakir	22	M	15980	RTA	Muller C3	closed	Right	LTPT	LCP	20	20-90	75		12WEEKS	Good
9	Karthik	25	Me	13521	RTA	Muller A2	closed	Right	AK Slab	DCS	12	10-100	80		5Months	Good
10	Saramma	65	F	65829	Fall	Muller A1	closed	Right	MTPT	LCP	12	10-120	90	-	12months	Excellent
11	Kannayan	67	M	18146	Fall	Muller A1	closed	Left	UTPT	DCS	14	0-100	86		6Months	Excellent
12	Eswara Vadivel	33	M	11224	RTA	Muller C2	closed	Right	Ak slab	DCS	20	15-90	**66**	Wound Gap	6months	Fair
13	Shakeer Basha	40	M	21588	RTA	Muller C3	closed	Right	AK Slab	DCS	18	20-95	68		8months	Fair
14	Radhakrishnan	41	M	31384	RTA	Muller C3	Closed	Left	MTPT	LCP	16	10-100	**82**	Knee stiffness	7months	Good
15	Ramamoorthy	64	M	50433	RTA	Muller C3	Gr II	Right	External fixation	LCP	16	20-80	**68**	Knee stiffness	9months	Fair
16	Sarath kumar	18	M	42253	RTA	Muller C3	closed	Right	MTPT	LCP	12	10-100	**84**	-	4months	Excellent
17	Venkatesan	33	M	33695	Fall	Muller A2	Closed	Right	UTPT	DCS	12	20-70	**55**	Infected-Implant exit	6 months	Poor
18	Muthu	48	M	80889	RTA	Type A1	Closed	Right	LTPT	DCS	14	10-90	**66**	2cm Shortening Varus deformity	4months	Fair
19	Krishna Moorthy	45	M	72789	RTA	Muller A3	Closed	Left	MTPT	LCP	20	10-120	**92**	-	10months	Excellent

20	Lakshmi	75	F	168440	Fall	Type A3	Closed	Left	MTPT	LCP	16	0-90	**82**	-	7months	Good
21	Malliga	70	F	79033	Fall	Muller A1	Closed	Right	UTPT	DCS	16	0-100	**86**	Varus deformity-15	6months	Excellent
22	Karthik	29	M	48980	RTA	Muller A3	Gr I	Right	MTPT	LCP	12	0-100	**84**	-	14Months	Excellent
23	Lakshmi	45	F	1575	Fall	Muller A2	closed	Right	UTPT	DCS	14	0-110	**86**		8Months	Excellent
24	Kasi	52	M	12419	RTA	Muller C3	Gr II	Right	Ext fix	LCP	16	10-90	**68**	Shortening 2 cm	7months	Fair
25	Gunasekaran	26	M	31461	RTA	Muller C2	Gr II	Left	Ext fix	LCP	20	10-90	**60**	Shortening 2cm Knee stiffness	5months	Fair